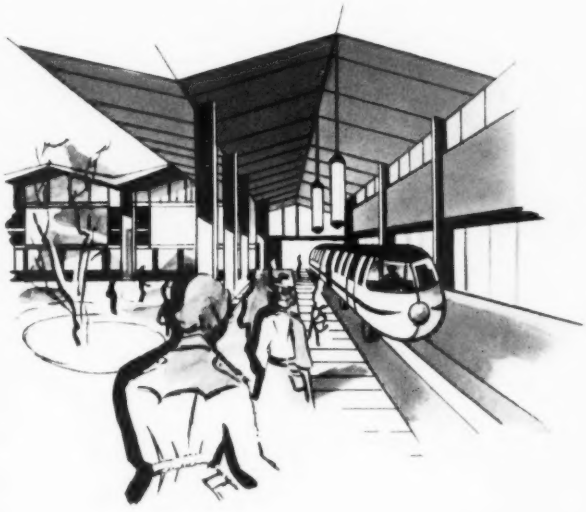
10 FEBRUARY 1961

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS



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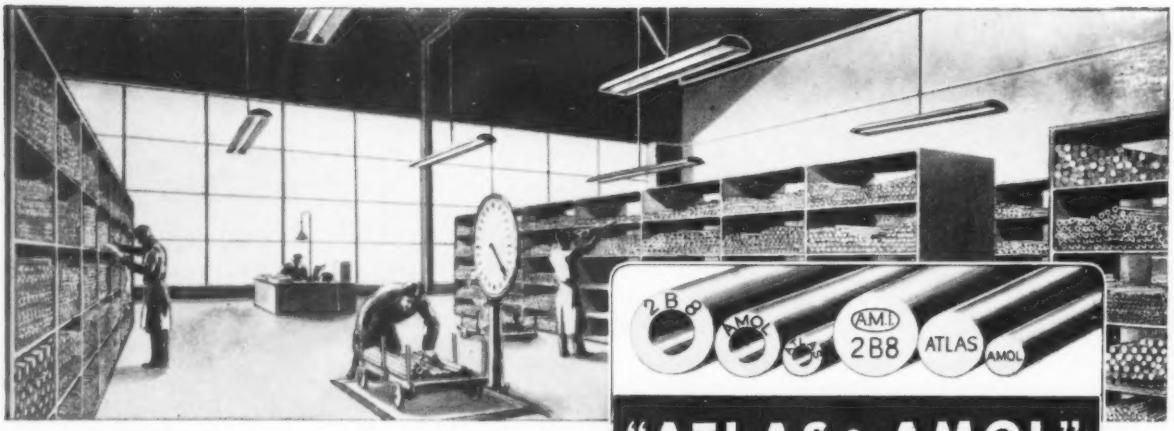

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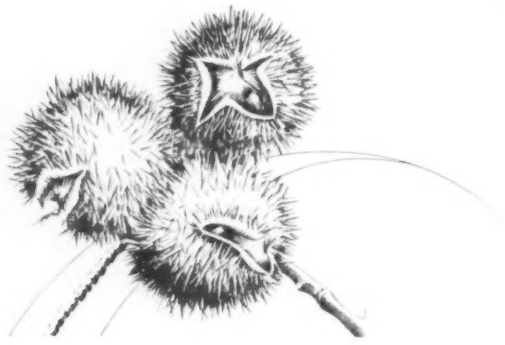

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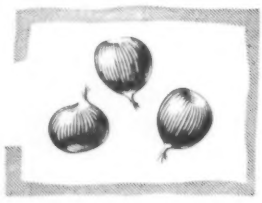

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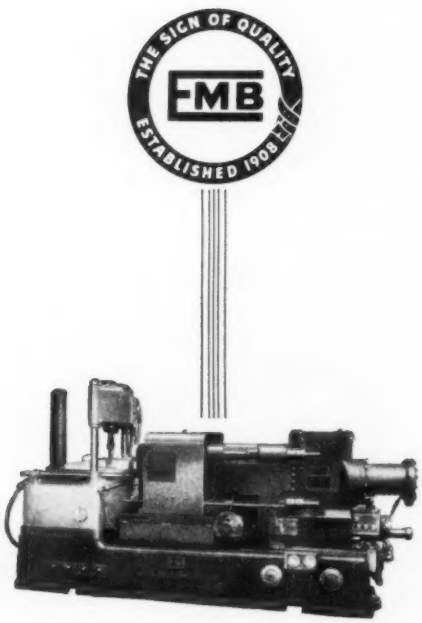

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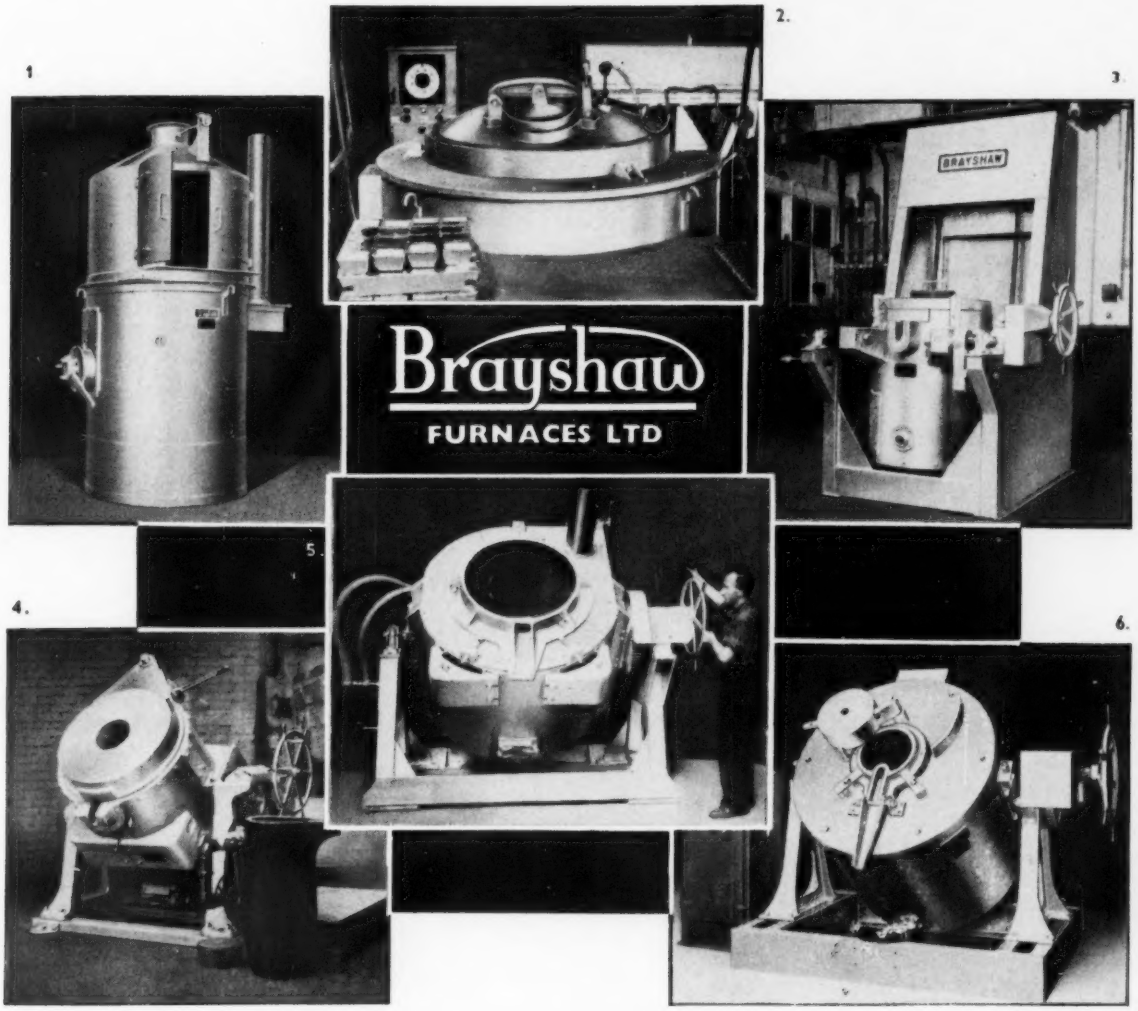

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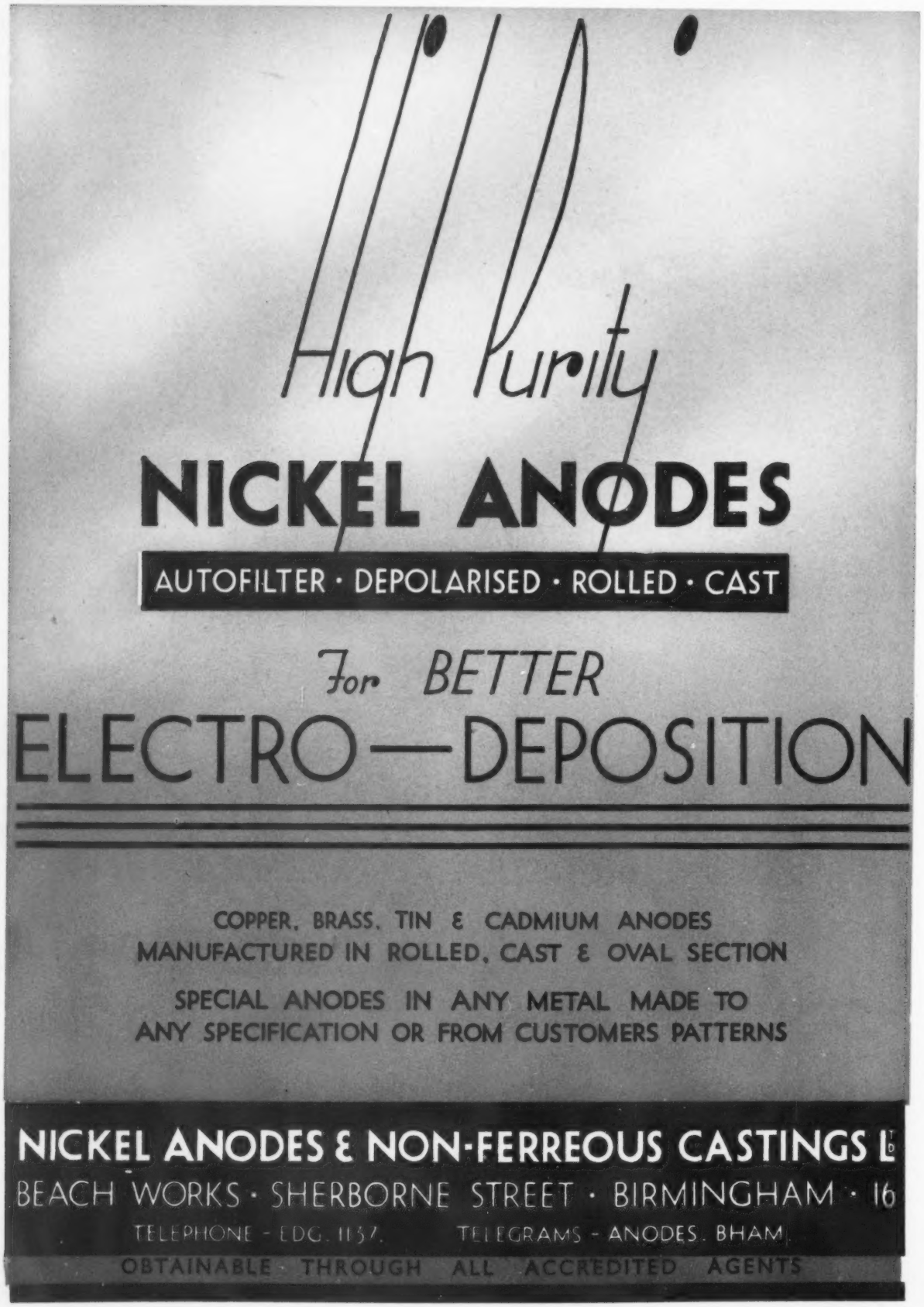
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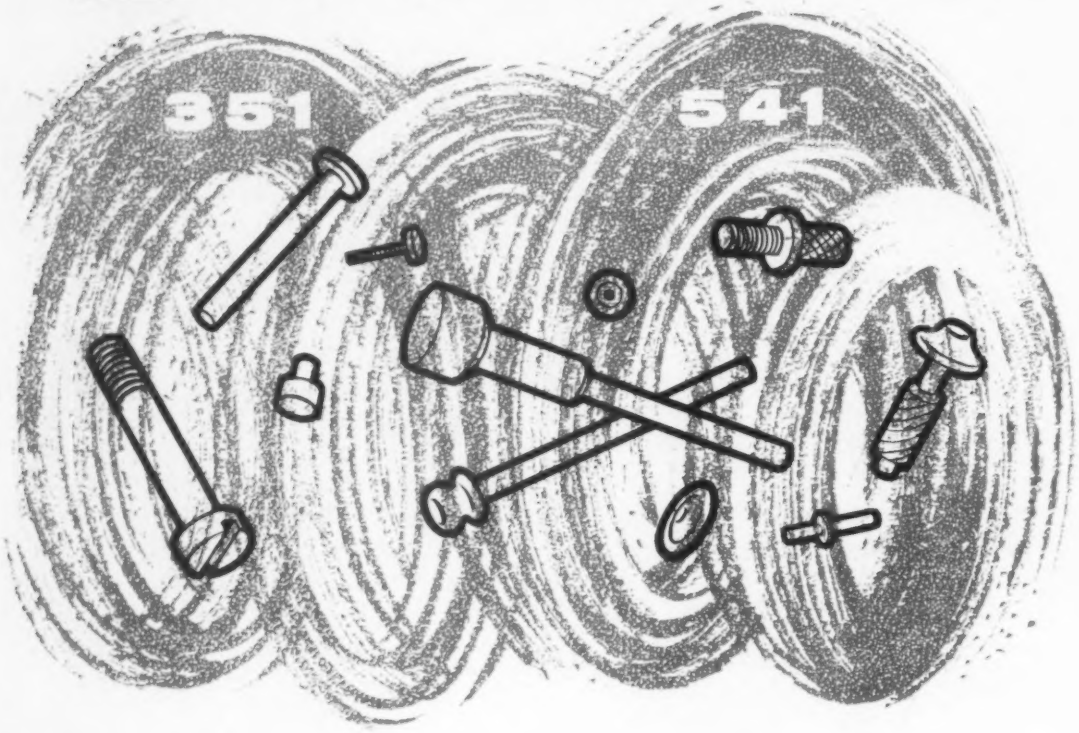

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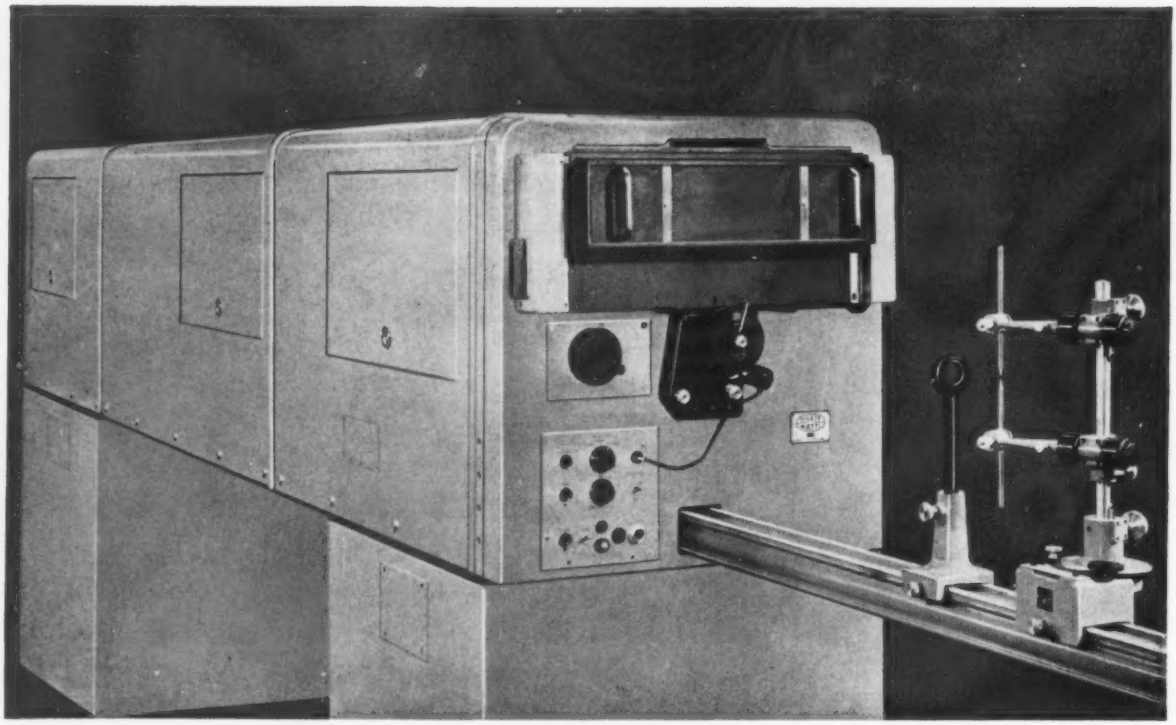

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FOUNDED 1909

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CONTENTS

	Page
Editorial: Get Together	101
Out of the Melting Pot	102
Titanium Sheet Forming. *By A. T. Carse and W. T. Ardis*	103
Men and Metals	107
Magnetic Extraction	107
Preparation of Thorium	107
Metallurgical Conversazione	108
Iron in Aluminium-Magnesium-Silicon Alloys. *By M. Paganelli and F. Sacchi*	109
Reviews of the Month	111
Standard Specifications	112
Industrial News	113
Forthcoming Meetings	115
Metal Market News	116
London	
Birmingham	
New York	
Zurich	
India	
Non-Ferrous Metal Prices	117
Scrap Metal Prices	118
Foreign Scrap Prices	119
Financial News	119
New Companies	119
Light Metal Statistics	119
The Stock Exchange	120

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In some cases the existing procedure of a producer is accepted as the best practice of the art and is taken as a basis for the standard in question. Thus British Standard 1004 (Zinc Alloy for Die Casting) was based on the established practice of the Imperial Smelting Corporation in the production of Mazak.

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METAL INDUSTRY

VOLUME 98 NUMBER 6 10 FEBRUARY 1961

Get Together

MODERN marketing techniques all have one aim in view: more efficient distribution of a greater volume of goods to an ever-increasing population. Until recent years the producers of primary metals, apart, perhaps, from aluminium, have not thought it necessary to adopt such techniques themselves because the end products manufactured from their materials pass through so many hands before reaching the ultimate consumer. But, with the need to develop markets capable of absorbing greatly increased production tonnages, and with the ever-growing competition from alternative materials, there is no doubt that the time has come when they must revise their marketing techniques. In this respect they might well take a leaf from the book of the American producers of stainless steel who, according to our contemporary, *American Metal Market*, are about to launch a nation-wide scheme to promote the sales of stainless steel consumer goods.

Primarily developed by the International Nickel Co., for reasons which need no stressing, and backed by manufacturers and the Committee of Stainless Steel Producers, the major goal of the scheme is to convince department stores that they can increase sales by installing a permanent shop featuring consumer products made of stainless steel. This is not the first attempt; in point of fact it is the third. Last year, when tried out on a smaller scale, the average increase in shop sales of stainless steel goods was 34 per cent, and over half of the participating stores are establishing permanent stainless steel consumer goods shops.

To ensure success of this year's scheme, Inco are advertising it widely in magazines and newspapers and on the radio. They are also providing department stores with kits containing counter toppers, sample advertisements, window displays, stainless steel ribbon and other promotion pieces. Stainless steel producers, not all of them using the same approach, are attacking the consumer market on two levels—national and local. They are contributing television time, national advertising, direct mail, and providing training programmes for department store sales personnel who have the ultimate job of selling to the consumer; a few companies are even providing store demonstrators. Several producers will use their own house magazines to stimulate the use of stainless steel consumer products among their own employees. Fabricators are offering special prices on certain stainless steel items to stores to help them increase sales. Stockists are being urged to step up contacts with their local manufacturers of stainless steel products and to promote their use among their own employees. Supplementing the major effort with the large department stores, a more modest programme is aimed at individual shops.

It is rather interesting to note the reasons why the producers are backing this sales promotion effort. Thus, one large company believes the scheme falls within its philosophy of selling "beyond our customers" either to maintain or increase sales of its products. Another, although most of its customers are industrial, is participating because of the goodwill and the fact that if it helps to establish permanent stainless steel shops, it is bound to benefit in the long run. Holloware manufacturers themselves are co-operating because, in a market so competitive, mass market penetration is the key to profits, and because any scheme which draws the consumer's attention to stainless steel benefits all manufacturers, even if their products are not on display.

All-in-all, this model scheme shows how companies in any metal selling chain from basic producer to ultimate consumer can profit from mutual co-operation. If such a scheme is worth while for a company whose product forms only 8 per cent of the composition of the metal being promoted, ought not a similar scheme for copper and brass products to appeal to the non-ferrous metal industry?

Out of the MELTING POT

Isostatic Effectiveness

ALTHOUGH the advantages of hydrostatic (isostatic) pressing of powders are generally appreciated, relatively restricted use has so far been made of the technique in the powder metallurgy field. Interest, therefore, attaches to some confirmatory quantitative evidence obtained in experiments in which hydrostatic pressures from 10 to 60 kg/mm^2 were used to compact various metal powders—copper (electrolytic), iron (eddy mill), nickel (electrolytic) and molybdenum (reduced)—into rod-shaped specimens having an initial size of 11 mm. diameter and 65 mm. length, the all-round reduction in dimensions on pressing being 25-30 per cent. The density and compressive strength of the compacts were determined and compared with those of compacts produced from the same powders by pressing in a die using the same pressures. The results for the variation of density with pressure showed that, as was to have been expected, isostatic pressing produced higher densities in all cases, but was especially effective with fine powders of the harder metals. Thus, densities were produced in nickel and molybdenum compacts by hydrostatic pressures 30-50 per cent lower than those that were required to produce the same densities in die pressing. For the copper powder, the hydrostatic pressure was 20-30 per cent lower, but only 10-20 per cent lower in the case of the relatively coarse iron powder. The compressive tests on specimens of the compacted powders showed that, again as was to have been expected, the die pressed compacts exhibited marked anisotropy, particularly at the lower compacting pressures and in the case of the harder powders (e.g. molybdenum as compared with copper). In isostatically produced compacts, the compressive strength was the same in all directions and (for equal pressures) was substantially equal to the maximum strength (in the direction of pressing) of die-pressed compacts in the case of copper, and much higher (20-130 per cent) in the case of molybdenum powder. The evidence of these tests and of some determinations of ejection pressures as a measure of the friction of the powders against the die, is taken as indicating that the different behaviour of metals of different hardness in isostatic and die pressing is to be ascribed to differences in the readiness with which bonding between the particles of the powder takes place.

Gaps

WITH the breadth of scientific and technical developments being what it is today, quite narrow specialization is essential if useful progress is to be made in any given sector. Some of the consequences of this specialization have, however, been left to take effect gradually and without anything much being done about them. Most of them are connected with the loss of any possibility of a broad interest in specialized progress. Such an interest nowadays presupposes too much understanding of the basis, meaning and possible future achievements of new developments for it to be at all widespread. This restricted interest is, however, masked by the relatively large numbers of specialists engaged in research on particular subjects. The lack of a general appeal of narrow specialization becomes apparent, however, in attitudes towards science and scientists. It is not insignificant, for example, that the connotations of the term "boffin" are not without affinity to the attitudes of misunderstanding, mistrust or at best tolerant amusement towards scientists that existed in the early days of science. Although nothing much can be done about these and other consequences of specialization themselves, a good deal could be done about the gaps left by the advance of scientific progress into specialized fields. To begin with, it would be most helpful if it were appreciated that such gaps are more apparent than real. Such a realization would ensure that whatever was done, or, in fact, is already being done, about them would not be in the nature of stop gap efforts, a vital difference so far as all those for whose benefit the attempts to fill the gaps are being made are concerned.

High Pressure

GIVEN the achievement of the industrial production of synthetic diamonds, the potentialities of research on the behaviour of materials at very high pressures and temperatures hardly need any additional special emphasis. In addition to the promise of the predictable, there is also the attraction of the totally unexpected. The conversion of graphite into diamond under the appropriate conditions of temperature and pressure was foreseen a long time ago, leaving only the fortunate discovery of the catalytic effect of certain metals to permit its realization under more readily attainable conditions, and, of course, the development of the necessary equipment. For many other materials there still exists the exciting possibility that the "simple" process of applying a very high pressure at a high temperature will bring about a transformation to a hitherto unknown phase with remarkable properties. In the meantime, metallurgical research at high pressures—the subject and title of a lecture to the Institute of Metals by Dr. J. E. Hilliard, of the General Electric Laboratory, Schenectady—having added pressure to the few other more familiar variables of composition, temperature and time, is proceeding to investigate its effects on phase equilibria and on the kinetics of such processes as precipitation and the movement of dislocations. Several types of equipment for applying high pressures have been developed, with facilities for heating, and even taking X-ray diffraction photographs of materials while under pressure. Pressure calibration and temperature measurement in this equipment are now believed to have attained reasonable certainty and accuracy. Results so far have been in general agreement with theoretical expectations: phase changes, e.g. the gamma-alpha transformation in iron, where they are accompanied by a reduction in volume, have been stabilized at lower temperatures by the application of pressure. The effect of pressure on diffusivity has been found to result in a reduction, very large in some cases, in the rate of, for example, precipitation processes in solid solutions and in the slowing down or prevention of the movement of dislocations during annealing. A great deal still remains to be investigated. As regards the practical value of this research, it may in due course arise from some combination or other of the facts that are being established, or from some chance discovery that may be encountered in the process. In such cases, the feeling is that production use would follow on a scale which, although it is hardly ever likely to be large, would be quite adequate to meet the requirements of, for example, micro-miniature electronic components.

Skimmer

TECHNIQUES DEVELOPED FOR USE ON STANDARD AIRCRAFT WORKS EQUIPMENT

Titanium Sheet Forming

By A. T. CARSE and W. T. ARDIS

(*Short Brothers and Harland Ltd.*)

Before embarking on full scale production of titanium components, Short Brothers carried out investigational work to discover what could be achieved with normal equipment. This Paper, which was presented at a Symposium on "Titanium Production Methods in the Aircraft Industry", organized by the Metals Division of Imperial Chemical Industries Ltd., at their Waunarlwydd works describes some of the results and the techniques employed.

COMMERCIALLY pure titanium has been in use for fabricating aircraft components at Short Brothers for four or five years, and production techniques are now an accepted part of the everyday job. Before introducing this material in the workshops, a fairly comprehensive programme of development tests was undertaken to find out what could be achieved on conventional plant and equipment.

As a natural corollary, similar development approaches are being applied to the higher-strength aluminium/tin and aluminium/vanadium alloys, ICI.317, 318A and Ex.011.

Scope of Investigation

A survey of typical aircraft components in production at the time the programme was begun indicated several applications where titanium could be used as an alternative material.

The most important of these was a section of the Short "Sperrin" leading edge anti-icing duct assembly (Fig. 1), chosen because it presented a variety of sheet manipulation processes and, being in stainless steel, provided a ready comparison of strength/weight ratios. The individual components are shown in Fig. 2.

In addition, certain other components were chosen so that processes not involved in the manufacture of this duct could also be examined.

The forming processes investigated covered: rubber pressing, brake pressing, drop hammer forming, stretch wrap forming, wheel forming, section rolling and drawing, and hot dimpling.

Materials

These investigations were not confined to British materials, but also embraced materials of American origin. i.e. TI.75A from Titanium Metals Corporation and RC.55 sheet and strip from Remington Crucible. Material thicknesses ranged from 24 to 12 gauge.

General non-flatness was apparent on practically all material received. This was most marked on the thinner gauges and suggested their unsuitability for use on components requiring a large, flat area.

Improvements have been made, and the commercially pure titanium now received is of a fairly high standard, but some of the alloy sheets now being worked are still unsatisfactory in this respect.

Blank Preparation

To effect economic use of material, developed blank layouts were made for each sheet with identification and cutting instructions. In addition, each layout included control specimens to facilitate investigation of the tensile properties throughout the sheet.

Light alloy blanks were used for proving developed strip widths and tool settings on the brake press. Where possible, at least one light alloy and one stainless steel counterpart were completed for comparison.

The preparation of the blanks for forming was accomplished mainly by guillotining or rotary shearing, with a limited amount of hand shearing, coil slitting and sawing. All blank edges were draw-filed and polished, prior to forming, to remove potential "stress raisers".

Blanking and piercing of 24 to 16 gauge specimens was accomplished without any undue difficulty. Power requirements and die clearance as used for stainless steels proved adequate. An inherent tendency to gall and pick-up was largely counteracted by applying molybdenum disulphide and by maintaining sharp cutting edges on the dies.

Preliminary Forming

In preliminary forming trials, employ-

Fig. 1—Anti-icing duct assembly

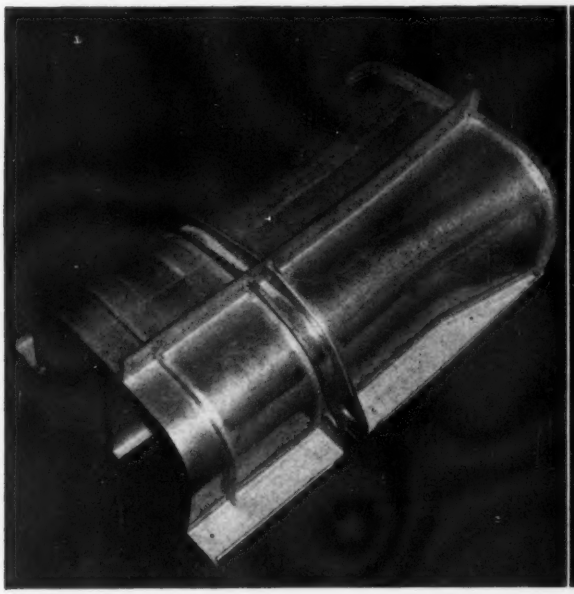
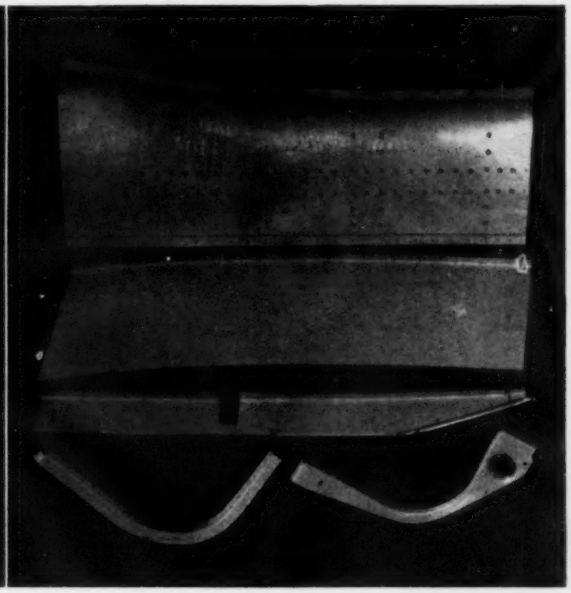
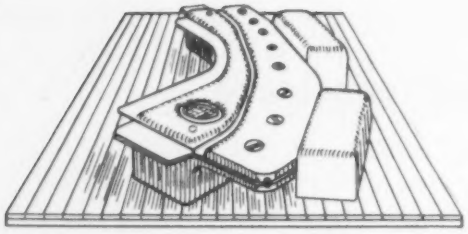


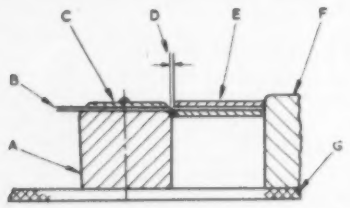
Fig. 2—Components for anti-icing duct



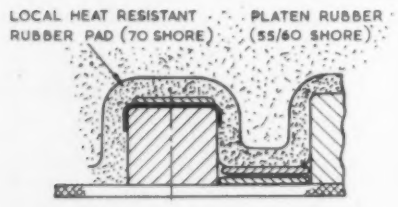


Left: Fig. 3—Rubber press tool set-up for hot forming

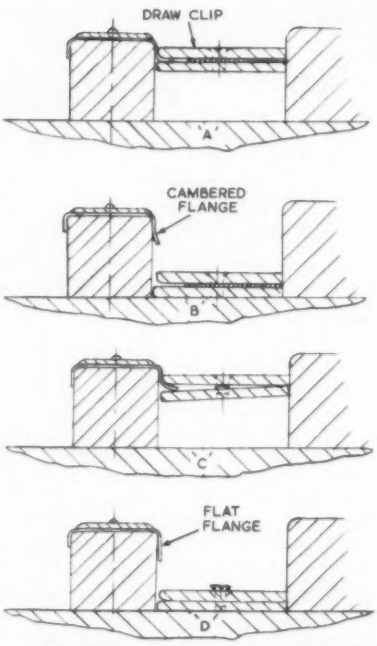
A—Form block. B—Component blank. C—Pressure plate. D—Material thickness. E—Drawclip. F—Guide block. G—Hard asbestos.



SECTION THROUGH SET-UP BEFORE FORMING



SECTION THROUGH SET-UP DURING FORMING



Right: Fig. 5—Rubber press forming of deep shrink flanges with drawclips. Severe drawing condition (A), results in laterally cambered shrink flange (B). Slackening off drawclip attachment screws (C), effects a less severe drawing condition resulting in a laterally flat flange (D)

ing the brake press and rubber press, different degrees of formability were exhibited by materials from the different manufacturers.

Of the three materials used, ICI.130 proved the most ductile and was readily formed at room temperature with bend radii down to 1½T in both directions of grain flow.

Although forming without fracture at room temperature, RC.55 required hot forming to overcome excessive spring-back and wrinkling on contoured bend specimens.

Both straight and contoured bend specimens in TI.75A fractured at room temperature but formed satisfactorily when the blanks were heated to 250°-300°C.

It is only fair to mention that the American materials were of early manufacture and that recent reports indicate a considerable improvement in both surface finish and formability.

Rubber Press Forming

The main components involved in the hydraulic rubber press forming tests were the anti-icing duct members, which presented a fairly wide variety of forming conditions for this process.

Forming was carried out on a Shaw type 8,000 ton hydraulic rubber press at room and elevated temperatures, using steel tools and pressure plates.

A heat-resistant 72 Shore rubber pad was used to protect the standard platen rubber during hot forming. Limitations of the rubber pad restricted forming temperatures to 250°-300°C.

Blanks for hot forming were raised to the required temperature by contact with tools and pressure plates, pre-heated to 300°C. on a simple gas burner arrangement adjacent to the press. A hard asbestos sheet was placed between the tools and the press table to minimize heat loss.

Blank location difficulty in hot forming, due to expansion, was overcome by slotting one hole in two pin location tools and both end holes in three pin tools.

American Materials

The preliminary trials having indicated the need for hot working, the various duct members in both American materials were formed on hot tools, employing a press pressure of 2,600 lb/in^2. Parts with shrink flanges were formed with the aid of steel draw clips, using powdered graphite as a lubricant. Bend radii for all parts was 3½T (Fig. 3).

Fig. 4—Typical components made by hot forming

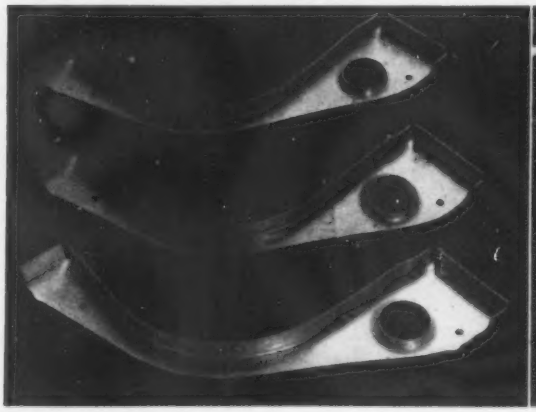
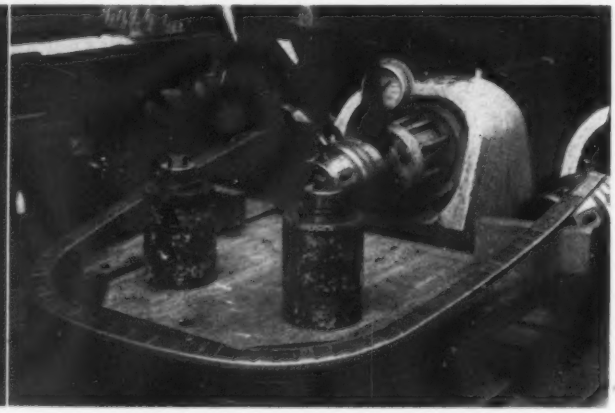


Fig. 6—Hufford A10 stretch-forming machine



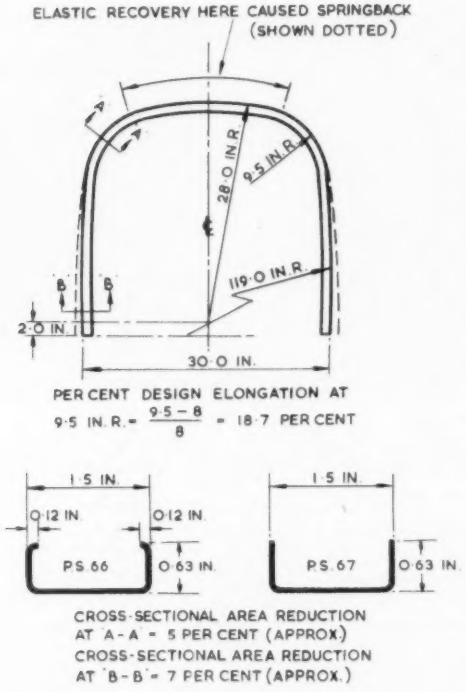


Fig. 7—Stretch-formed fuselage channel frames formed from 24 S.W.G., R.C. 55 commercially pure titanium

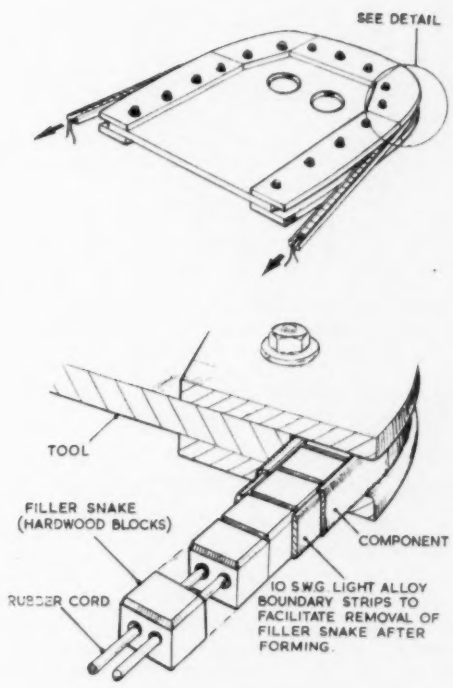


Fig. 8—Tools for stretch-forming fuselage channel frames

Good results were obtained by this procedure, all the parts being produced without fracture. Stretch flanges were laterally flat, and joggles and lightening hole flanges well formed. Slight shrink flange wrinkling at the 2 in. contour bend radii on the parts shown in Fig. 4 was easily removed by subsequent bench adjustment, using heated tools. Some attention to clearance between the draw clip plates was required for shrink flange forming. A gap of 1½ times the material thickness was satisfactory for a flange width of $\frac{1}{4}$ in., but produced a laterally cambered $\frac{3}{8}$ in. flange. By increasing the gap to 4T for this width, flat, wrinkle free, flanges were obtained (Fig. 5).

The springback allowance of 4° on the tools proved adequate.

British Materials

With the assistance of two 72 Shore rubber pads to intensify press pressure and draw clips for shrink flanges, duct members in 24 and 20 gauge ICI.130 material were successfully formed at room temperature. These cold formed parts compared favourably with those hot formed in American materials.

Attempts to produce contoured parts cold in 16 gauge ICI.130 were not successful, due to inadequate press pressure, but acceptable components were produced at room temperature after blanks had been annealed for 30 min. at 650°C. prior to forming.

From these preliminary tests it was concluded that rubber press forming of commercially pure titanium sheet could be accomplished either hot or cold, depending on material grade, type of tooling and press pressure employed. Tooling aids improve accuracy under both conditions, particularly on parts having shrink flanges, and reduce the amount of post forming adjustment required.

Evidence of sheet panting on the webs of some of the larger components emphasized the need for improvement in material flatness in the "as received" condition.

For best results working radii on tools should be consistent and smoothly finished and contours truly blended. Joggle dimensions on dies should be 0·015 in. deeper than component dimension to allow for springback.

Blanks having sheared edges should be polished, especially in regions of severe deformation such as stretch flanges and flanges of lightening holes.

Stretch Forming

In stretch forming trials, using pre-formed commercial titanium sections, aircraft frame members representing some of the more difficult problems in the process were investigated.

Pre-forming of the sections was carried out on the brake press. Bend radii was 3½T for the American materials and 3T for the British.

All stretch forming was carried out at room temperature on a Hufford A.10 machine (Fig. 6).

One factor which showed up in these

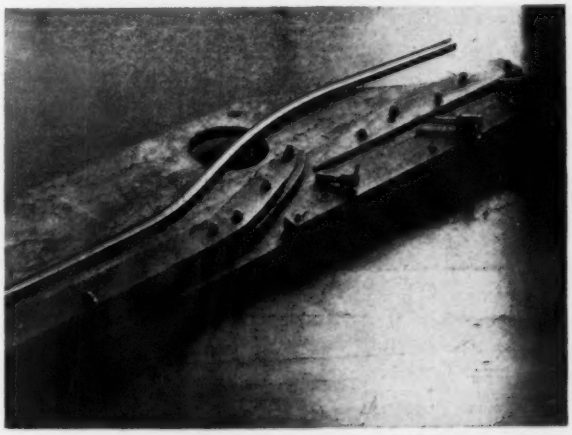
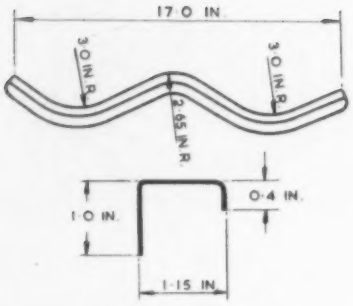
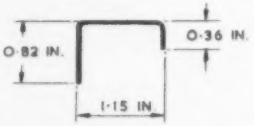


Fig. 9—Lipped angle boundary member for rib root boom

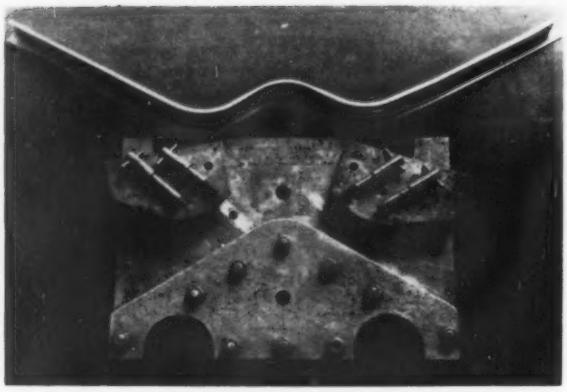


DESIGN SECTION

RESISTANCE TO COMPRESSION CAUSED BUCKLING



SECTIONS AT 'A-A' SHOWING FLANGE LOSS RESULTING IN A 9 PER CENT CROSS-SECTIONAL AREA REDUCTION.



Left: Fig. 10—Stretch-forming of W-shaped reinforcing angle

Above: Fig. 11—Tools used for stretch-forming W-shaped reinforcing angle

trials was the difference in material creep. In the forming of ICI.130 parts creep was barely perceptible, whereas it was most pronounced on the RC.55 parts, and extreme care had to be exercised when stretch forming to avoid excessive necking.

In forming 24 gauge fuselage channel frames (Fig. 7), best results were obtained by slowly applying sufficient tension to yield the material and induce plastic flow, followed by interrupted wrapping and holding at load whilst vibrating the die to overcome friction at high strain areas.

Attempts to reduce springback of $1\frac{1}{4}$ in., by increasing tension after wrapping, accentuated necking tendencies, resulting in cross-section reductions. Flange width reduction on lipped and unlipped parts was 9 per cent and 13 per cent. Tools for these parts are shown in Fig. 8.

The typical lipped angle boundary member (Fig. 9), having fairly gradual reverse contours, required two wrapping operations.

Good results were obtained by slowly applying sufficient tension to yield the material and induce plastic flow, whereupon wrapping was commenced and completed without increasing the load. Vibrating the die at this stage assisted material creep to effect maximum conformity to die contours. Springback of $\frac{1}{4}$ in. was not considered excessive, the part conforming to the die contour under light finger pressure.

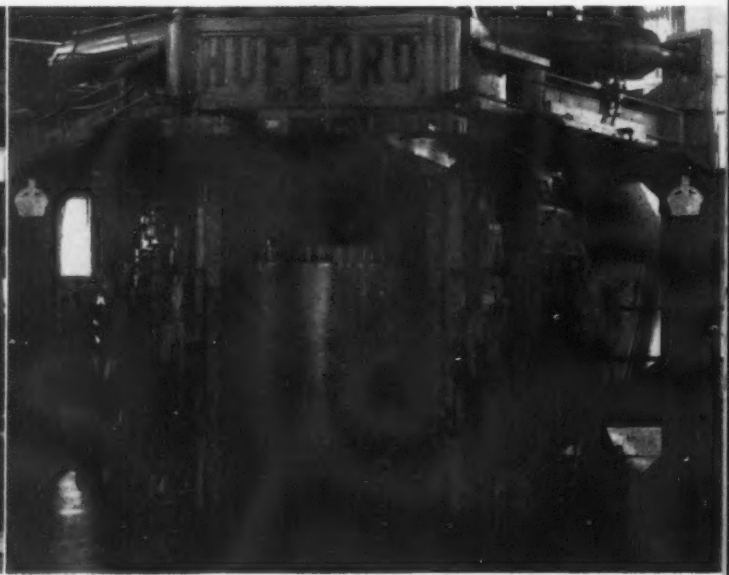
Maximum flange width reduction was 3 per cent.

The "W" shaped reinforcing angle (Fig. 10) required two operations. Parts in RC.55 and ICI.130 were formed at room temperature.

Best results were obtained by slowly applying sufficient tension to yield the material initially, with subsequent small increase in tension and holding at load for a period after each wrap.

Flange resistance to compression at the 2·65 in. contour radius, during the initial wrap, necessitated block and hammer assistance to obtain web conformity with the die, and to facilitate assembly of the reverse bend form blocks. Necking occurred in the high strain areas, resulting in a maximum width reduction of 18 per cent on the 1 in. flange and 12 per cent on the

Fig. 12—"Panting" during initial tensioning of stretch-formed sheet *Fig. 13—Wrinkling during final setting*



0·4 in. flange. Tools used are shown in Fig. 11.

Except for increased springback, stretch formed parts produced in both RC.55 and ICI.130 compare favourably with similar components produced in D.T.D.610 aluminium alloy. ICI.130 material, in fact, exhibits less springback than RC.55 and, with its reduced room temperature creep tendency, is much easier to control during stretching.

Apart from material properties, the degree of success achieved in forming titanium by this process is, as with other metals, influenced to a great extent by component design features. The chief limitation in this respect, as demonstrated in the forming of the reinforcing angles, is the width of flanges in the plane of curvature, particularly on severe contours.

Return flanges or lips on the tension side of sections help to counteract necking tendencies and flange width loss.

Springback on dies is necessary to obtain maximum uniformity with minimum stretching.

Sheet Stretch Forming

For sheet stretch forming trials on the Model 46 Hufford machine, a typical double curvature fuselage panel, containing mild longitudinal and marked transverse contour, was selected.

Forming was carried out at room temperature, using a high pressure deep drawing lubricant on the die surface.

Panting, present on both sheets during initial tensioning (Fig. 12) was forced, by contact with the die when wrapping, into severe wrinkling along the free area between the die and the gripper jaws.

Although it was suspected that the unequal stress distribution, caused by the wrinkles, would have an adverse effect, final setting was attempted in both specimens (Fig. 13). In each instance, material failure at the jaws occurred before full forming could be achieved.

The 70 per cent form obtained, however, showed promise and was considered the maximum possible with the sheet in the "as received" condition.

(To be concluded)

Men and Metals

To fill the vacancies that will occur on the Council of The Institute of Metals at the forthcoming annual general meeting the following members have been elected: — **Professor H. O'Neill** (head of the Department of Metallurgy, University College of Swansea, Wales) to be President; **Sir Ronald Prain** (chairman and president, Rhodesian Selection Trust Limited) to be Past-President; **Mr. W. F. Randall** (deputy chairman and managing director, Telcon Metals Limited) and the **Rt. Hon. The Earl of Verulam** (chairman, Enfield Rolling Mills Limited) to be Vice-Presidents; **Mr. N. I. Bond-Williams** (managing director, The Aston Chain and Hook Company Limited), **Professor A. H. Cottrell** (Goldsmiths' Professor of Metallurgy, University of Cambridge) and **Mr. G. A. Rider** (deputy managing director, Birmid Industries Limited) to be Ordinary Members of Council.

In order to make room for promotion, **Sir Walter Benton Jones,** Bt., has retired from the board of Davy-Ashmore Limited and **Mr. M. F. Dowding** (general manager of the machinery division of Davy and United Engineering Company Limited) has been appointed a director.

As agreed in principle at the time of the Davy-Ashmore merger, **Mr. C. E. Wrangham,** formerly chairman of Ashmore, Benson, Pease and Company Limited, and of P.G. Engineering Limited, has resigned from the boards of these subsidiaries and **Mr. M. A. Fiennes** has been appointed chairman in his place. Mr. Fiennes is the managing director of Davy-Ashmore Limited.

Having reached normal retirement age, **Mr. A. E. Reddell,** O.B.E., has retired from the board of directors of Vickers-Armstrongs (Engineers) Ltd. and from his office of director-in-charge of the Weymouth works of that company.

It has been announced that **Mr. A. D. Lidderdale,** M.I.Mech.E., has been appointed general manager of Meybold - Elliott Limited, the new company recently formed by Elliott Brothers (London) Limited.

Appointed general manager of the newly created engineering division of Castrol Limited is **Mr. Richard Adams,** M.I.Mech.E.

To handle their business in the North, Vacuum Industrial Applications Ltd., of Wishaw, have appointed **Mr. Lionel Swindells** as Northern representative for all their high vacuum plant and accessories.

In order to strengthen its offices in the Provinces, West Instrument Ltd. have appointed **Mr. R. F. Hamman,** B.Sc., to their sales office in Manchester, and **Mr. Brian Francis,** B.Sc., to the engineering department at Brighton, where he will be joined by **Mr. Robert White.**

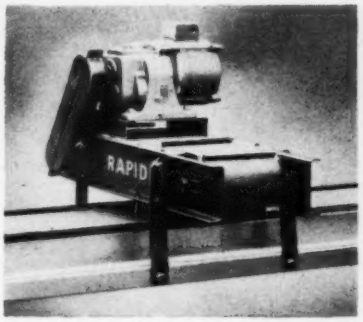
New appointments recently made by Joseph Gillott and Sons Ltd. include those of **Mr. D. Marsh** as representative in London and the Southern Counties, and **Mr. D. L. Duddy** as representative in Lancashire, Cheshire and the West Riding of Yorkshire.

Elected a director of the International Nickel Company of Canada, **Mr. G. Arnold Hart,** of Montreal, is President and chief executive officer of the Bank of Montreal. He fills the vacancy caused by the recent death of Mr. Edwin G. Baker.

Magnetic Extraction

FOR use with continuous plant having belt conveyors, vibratory feeders or other forms of carrier which provide uniform distribution of material to be treated, Rapid Magnetic Limited, of Lombard Street, Birmingham 12, have introduced a permanent magnetic overband separator.

This self-contained unit is positioned above and traversing the carrier, ferrous contamination being lifted clear and automatically discharged to the side. There is no need to stop the plant to clean, and no chance of iron accumulating on the magnet.



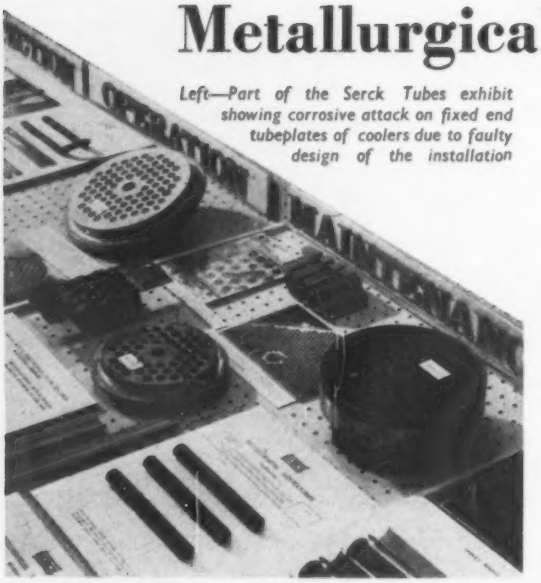
Constant power is assured by Alcomax magnets, electric power being required for the separator driving motor only.

Preparation of Thorium

TO meet a growing need for thorium metal of high purity and amenability to fabrication, the U.S. Bureau of Mines has devised a method for preparing thorium metal by the reduction of thorium tetrachloride.

In this process, thorium tetrachloride was prepared by chlorinating calcined thorium oxalate with carbon tetrachloride. The crude thorium tetrachloride, containing oxygen-bearing compounds, was purified by a double vacuum distillation at 800°-900°C., and thorium metal was made in the form of a dense sponge by the reaction of metallic sodium or magnesium with thorium tetrachloride at 800°C. Vacuum arc melting was used to consolidate the sponge metal to ingot form for evaluation of its physical and chemical properties.

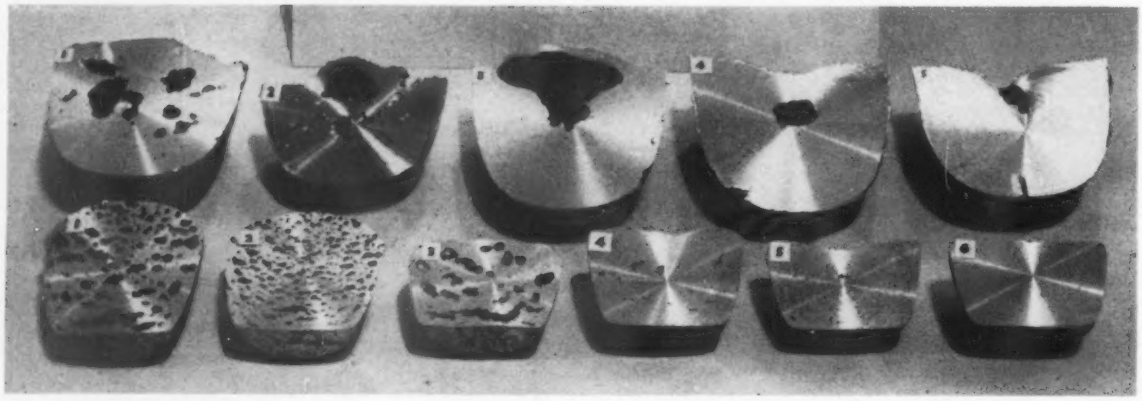
Metallurgical Conversazione



Left—Part of the Serck Tubes exhibit showing corrosive attack on fixed end tubeplates of coolers due to faulty design of the installation

LAST week, the Birmingham Metallurgical Society held its first Conversazione for members, students and guests. Metallurgical exhibits from industrial research establishments were on show, and 27 students' entries were exhibited. A display of students' work from the Birmingham School of Jewellery was also staged. Industrial exhibits included demonstrations and examples of research work by Birmetals Ltd., B.C.I.R.A., B.S.A. Group Research Centre, W. Canning and Co. Ltd., Coil Spring Research Association, Forgings and Presswork Ltd., Foundry Services Ltd., G.K.N. Group Research Laboratory, High Duty Alloys Ltd., Imperial Chemical Industries Ltd. (Metals Division), Johnson Matthey and Co. Ltd., Joseph Lucas Ltd., Metallisation Ltd., The Mond Nickel Co. Ltd., Nuffield Research Centre, Quasi-Arc Ltd., The Rover Co. Ltd., Serck Tubes Ltd., Tube Investments Technological Centre (The Chesterfield Tube Ltd.).

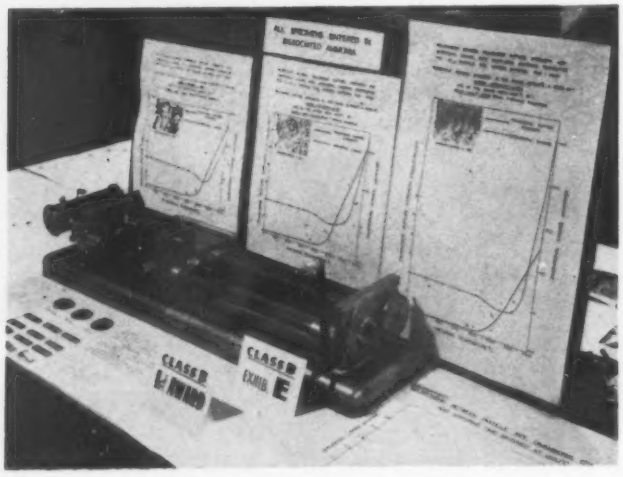
The students' exhibits were competitive entries in five classes covering practical work at O.N.C. level upwards. Prizes were awarded as follows:—Class A: 1, D. Tomlinson (Matthew Boulton Technical College); 2, B. Rowbothan (Matthew Boulton Technical College). Class B: 1, C. A. Wright (College of Advanced Technology); 2, D. C. Saunder (College of Advanced Technology). Class C: 1, J. E. Whittle (College of Advanced Technology). In Class D, two exhibits from four students at the County Technical College, Wednesbury—B. Millington, D. N. A. Bax, D. V. Thornton, H. D. Wilson—were placed equal.

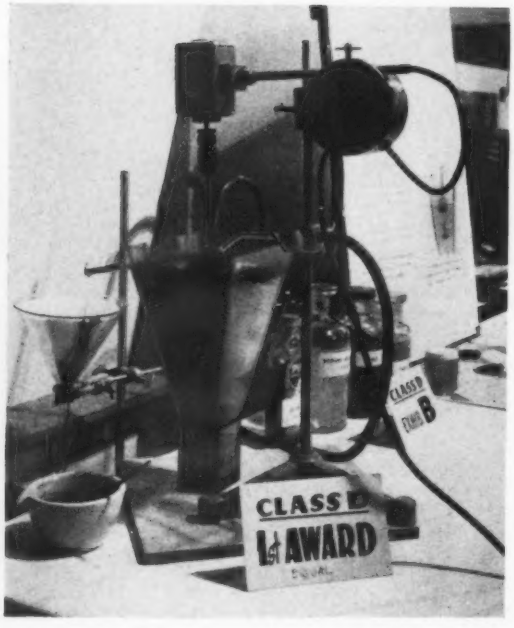


Above—Gas test samples on the Foseco exhibit showing a typical aluminium alloy and aluminium bronze at progressive stages of degassing

Right—One of the winning students' exhibits demonstrating the froth flotation of ores

Below—Students' prizewinning entry demonstrating method for determination of the influence of particle size on sintering of stainless steel





EFFECT ON MICROSTRUCTURE MECHANICAL PROPERTIES AND CORROSION RESISTANCE

Iron in Aluminium-Magnesium-Silicon Alloys

By M. PAGANELLI and F. SACCHI

(*Concluded from* METAL INDUSTRY, 3 *February* 1961)

ITALIAN Standards[5] name five grades of surface finish obtainable on aluminium - magnesium - silicon alloys anodized by the normal sulphuric acid process, namely: OTO—optical, BRI — brilliant, ARL — architectural bright, ARS — architectural scratch-brushed, GRE—untreated. The two latter finishes are unaffected by metal purity since variations in transparency of the oxide coating are masked by surface irregularities which are either natural (GRE) or artificially produced (ARS). In the present investigation, therefore, only response of the four alloys to optical, brilliant and architectural bright finishing processes were examined. The finishes were produced after a preliminary buffing treatment by electrolytic polishing, chemical brightening and pickling in 20 per cent caustic soda solution at 40°C. for 15 sec., respectively. All specimens were then anodized in 20 per cent sulphuric acid at 20°C. with a current density of 1·2 amp/dm^2 for 25 min., and sealed in boiling distilled water for 15 min.

In order to anodize the architectural bright finish so that the qualities of the base metal were revealed, the buffed specimens were first anodized, using alternating current at 1·2 amp/dm^2 for 15 min. This first anodic film was removed by etching in caustic soda and the surface brightened again by very lightly buffing, using a ventilated cloth wheel, which does not cause any appreciable heating of the surface. Disturbance of the surface layers is reduced to a minimum by using this type of "cold polishing", and more transparent oxide films are obtained. It is used when a high specularity is desired on sheet or on sections to be erected in prominent positions and the finish so produced is mid-way between the architectural and the brilliant grades. Results of brightening and anodizing tests, examples of which are reproduced in Figs. 9-14, indicate that:

(a) The range of finish obtained varied from optical quality, suitable for reflectors and car-trim, to ARL quality, suitable for architectural applications.

(b) Optical and brilliant qualities could only be obtained with 0·15 per cent iron or less. With higher iron only ARL quality finish could be produced, there being little difference between the behaviour of material with 0·3 per cent iron and that with 0·5 per cent iron.

(c) Deterioration in specularity due to increasing iron from 0·08 per cent to 0·15 per cent and from 0·15 per cent to 0·30 per cent was very pronounced.

(d) Anodic films on water-cooled extrusions were more transparent than those on air-cooled extrusions.

(e) Anodic films on naturally aged specimens were more transparent than those obtained after artificial ageing.

The influence on anodizing properties of iron content, of the method of quenching and of the type of ageing treatment employed were due to the fact that the presence of intermetallics, whether in the form of large crystals or fine precipitate, cause the oxide coating to be opaque.

Although no deterioration in anodizing properties was produced by increasing iron from 0·3 per cent to 0·5 per cent, it would not be advisable to increase the maximum iron allowed by the standard for the aluminium-0·65 per cent magnesium-0·4 per cent silicon alloy to 0·45 per cent, for example, which is allowed for the higher alloys of the series, because the applications of the alloy would then be limited to low quality finishes.

Accelerated Corrosion Tests

Two buffed and anodized specimens of each alloy in each condition examined were subjected to a continuous immersion test in 2·5 per cent NaCl + 1·5 per cent CH_3COOH + 0·1 per cent H_2O_2 solution. A comparison of the corroded surfaces after ten days' immersion indicated that:

(a) The influence of the method of cooling was pronounced, the water quenched materials always being corroded less than those air quenched.

(b) Type of ageing had a slight influence, particularly on air quenched specimens, the number and size of corrosion pits being appreciably greater after artificially ageing than after natural ageing.

(c) The alloy with 0·08 per cent iron was the most corrosion resistant, and

Fig. 9—Electrolytically polished and anodized extruded sections. Increase in iron reduces specularity. Specimens quenched in water are brighter than those air quenched. (×0·5)

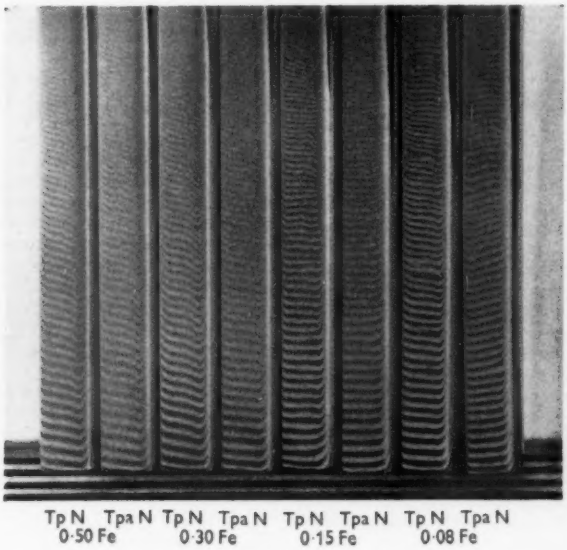
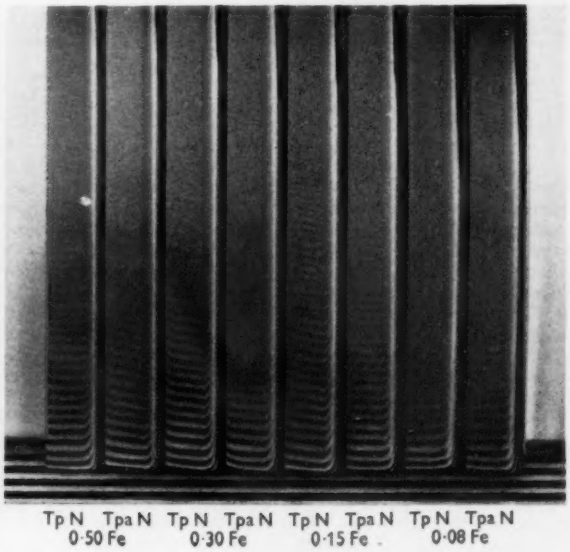


Fig. 10—Chemically polished and anodized specimens. (×0·5)



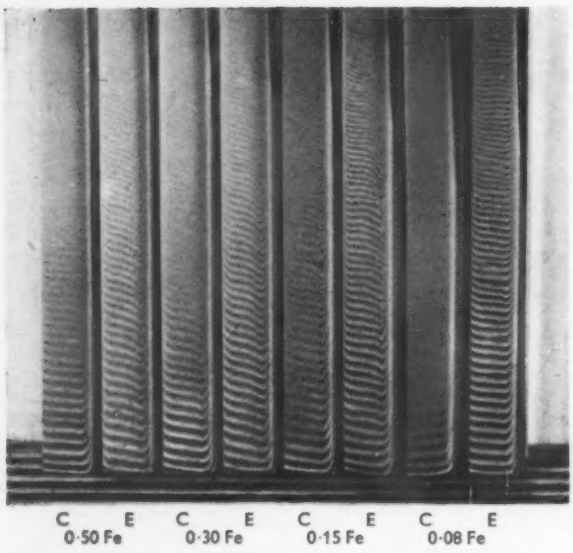


Fig. 11—Comparison between chemical and electrolytic polishing. Specimens in the water quenched and aged condition. (×0·5)

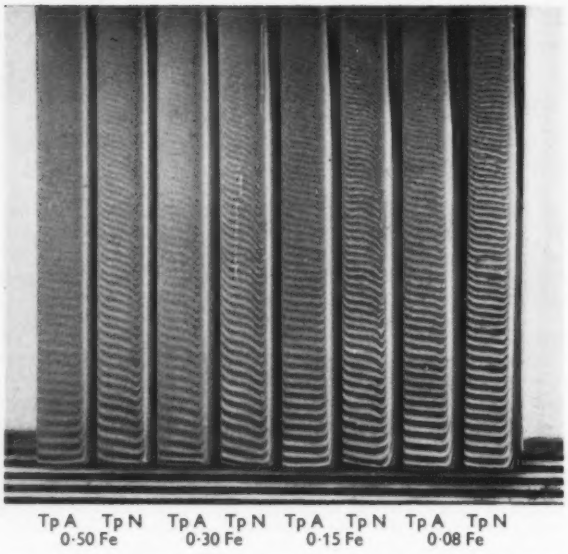


Fig. 12—Unfavourable effect of artificial ageing on brightness (×0·5)

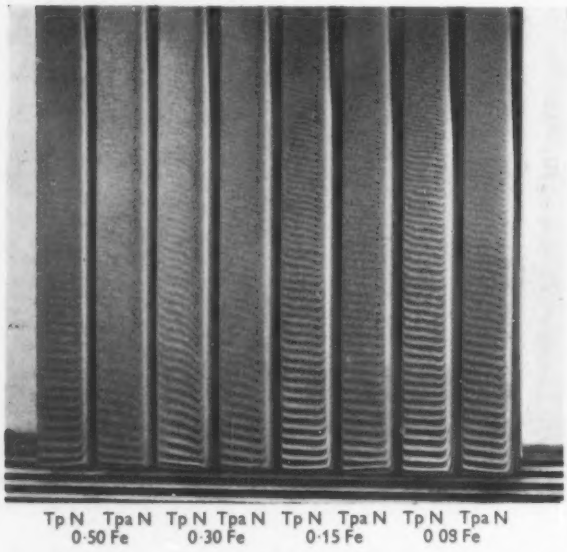


Fig. 13—Appearance of "cold buffed" and anodized specimens. (×0·5)

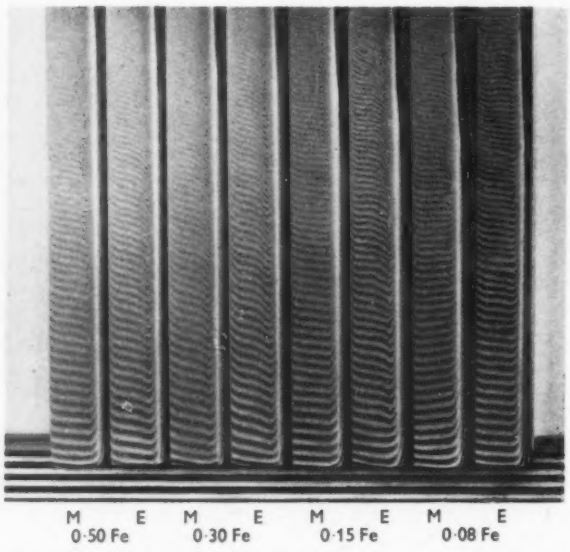


Fig. 14—Comparison between electrolytic polishing and "cold buffing" on water quenched and naturally aged specimens. (×0·5)

those with 0·15 per cent and 0·3 per cent iron were least resistant. At the highest level of iron, namely 0·5 per cent, however, corrosion resistance was almost as great as at the lowest level. The high corrosion resistance of the 0·5 per cent iron alloy was not due to its having a thicker oxide coating, for thicknesses of the anodized films were determined gravimetrically and found to be similar. It is, therefore, suggested that the resistance of the high-iron alloy was due to the large number of uniformly distributed $FeAl_3$ crystals which, it is believed, impeded localized attack as the intermetallic compounds in aluminium-nickel-iron alloys impede oxidation in high temperature water.

Conclusions

Effect of iron content on the mechanical and anodizing properties of the aluminium-0·65 per cent magnesium-0·4 per cent silicon alloy have been determined. Extrusions with four different levels of iron, each in six different conditions of heat-treatment were examined, the conclusions reached being listed below.

Mechanical properties are only slightly influenced by iron content, the best properties being obtained with 0·15 per cent iron.

The best mechanical properties are obtained in the Tp A condition, that is, quenched at the press in water and artificially aged.

With magnesium and silicon at the level examined, mechanical properties after re-solution treatment and artificially ageing do not meet the minimum values specified by the Italian Standard.

Anodizing tests indicated that with iron not exceeding 0·15 per cent the alloy is suitable for production of finishes of the highest quality.

Specularity is improved by water quenching rather than air quenching and by naturally ageing rather than artificially ageing.

For common architectural finishes, for example, for door and window frames, an increase in iron content would have little effect.

(*Concluded on page* 112)

Reviews of the Month

NEW BOOKS AND THEIR AUTHORS

BRITTLE FRACTURE

"The Brittle Fracture of Steel." *By W. D. Briggs. Published by MacDonald and Evans, 8 John Street, Bedford Row, London, W.C.1. Pp. ix + 420. Price 70s.*

A STUDY of the technical reports of engineering insurance companies pertaining to failures of prime movers and mechanical breakdowns should reveal the importance of such a book as this to metallurgists and engineers if they wish to understand some of the causes of sudden failures. The book has been compiled to provide a comprehensive review of the present knowledge regarding the brittle behaviour of structural steels.

In his classification of fractures, the author gives two types only, viz., "Ductile" and "Brittle" though the former may be shear or fibrous, while the latter may be cleavage or crystalline. If we look back to some of the earlier investigators like Brinell ("Stahl und Eisen", 1885), we find that he classified fractures into four types and subdivided these into several differentials. The reduction of such classifications during these 75 years does not mean that the study of metal fractures has become more elementary; far from it, there are many more complications evolved during these years with the advancement of physical metallurgy and atomic metal physics.

New definitions, such as "Neumann lamellae", "chevron pattern", "adiabatic fractures", "tenuous types", etc., are but few to designate the differences between brittle and ductile fractures.

The "apparently inexplicable" failures of the American welded ships in the early part of the 1939-45 war years and the "insufficient data available to explain the cause of such failures" appears to be strange to this reviewer, who carried out some of the examinations of the ships which came to the Clyde for repairs. The failures were due to the use of a high oxygen ingot iron being used for the ship plates. Such steel is known to have a critical embrittling factor when stressed between certain elevated temperatures, or failure may result from "ageing", caused by oxide precipitation from a quickly cooled (quenched) material. Unwittingly, this type of steel was used during an acute shortage of steel, before it was realized that this most ductile of steels was unsuitable for ship plates which had to be welded by the metallic arc process. However, the author does mention, on page 290, that this type of brittleness can occur from grain boundary oxides.

Unfortunately, the reviewer missed the mention of brittle fractures resulting from "hydrogen" or caustic embrittlement of steel under tensional stress. Almost each year during the last 40 years there have been many failures from this cause in this country and in other countries. This is an excellent book and can be fully recommended to metallurgists and engineers who may be concerned with failures in metals.

D. Ll.

CRYSTAL GROWTH

"Growth of Crystals." *Vol. 2. Edited by A. V. Shubnikov and N. N. Sheftal. Published by Consultants Bureau Inc., New York, and Chapman and Hall, 37 Essex Street, London, W.C.2. Pp. vii + 178. Price 128s.*

THIS book is a translation from Russian of the second volume of a series dealing with crystal growth and, to some extent, represents work that has been done in the U.S.S.R. since the first Soviet conference on crystal growth in 1956. It contains nine Papers in Section I devoted to theoretical and experimental work; thirteen in Section II devoted to apparatus and methods for growing monocrystals; and three review and discussion Papers in Section III.

The first three Papers by V. YA. Khaimov-Mal'Kov ("The Thermodynamics of Crystallisation Pressure", "Experimental Measurement of Crystallisation Pressure", and "The Growth Conditions of Crystals in Contact with Large Obstacles") give the results of a careful investigation in a field where agreement between different workers is rare; and it must be stated at the outset that these three Papers are the only ones which exhibit a high standard of presentation. Four of the remaining six Papers in the theoretical and experimental section ("The Crystallisation of Alum from Water in an Ultrasonic Field", "The Adsorption of Thionin Blue by Growing Lead Nitrate Crystals", "The Growth Forms of Thiazine Dye Crystals", and "The Crystallisation of KI in Contact with Biotite and Muscovite") are similar in content and form to a "Research Note" or a "Letter to the Editor", and of the other two Papers, one ("The Green and Brown Colours of Synthetic Quartz Crystals") describes the effects of corrosion of the steel autoclaves on the colour of the quartz produced therefrom, and the other ("Determination of Surface Energies of Crystals from Equilibrium States") extends the results of a Paper published elsewhere in order to give designs for an experiment which should enable surface energy to be measured.

In the section devoted to apparatus and methods of growing monocrystals, six Papers are similar to a "Research Note": ("Growing Monocrystals of Anthracene", "The Orientations of Monocrystals of Certain Ferrites", "The Growth of Barium Titanate Crystals from a Barium Chloride Melt", "Synthesis of Especially Pure Calcium and Barium Fluorides for Growing Optical Monocrystals", "The Effects of Cooling Conditions on the Formation of Dislocations in Germanium Crystals", and "The Crystallisation of Germanium on Silicon and of Silicon on Germanium"); two Papers are similar to a "Workshop Note": ("A Crystalliser for Growing Organic Crystals from the Melt", and "A New Type of Pistonless Compressor for Producing Very High Gas Pressure"); and two Papers adequately deal with the subject matter of the section: ("Growing Calcite and Other Carbonates", and "The Growth and Morphologic Symmetry of Benzophenone Crystals"). Two of the remaining three Papers of this section could have been included in Section I with equal justification. "The Crystallisation of Ferrites from Liquid and Vapour Phases" gives experimental details of the growth of Mn and Zn ferrite monocrystals from solution in molten fluorides and borax, and presents the results of detailed measurements in the form of graphs. "Guanidine Aluminium Sulphate Hexahydrate" gives experimental details of the synthesis of the compound, its preparation as monocrystal by evaporation of aqueous solution, and presents the results of goniometric, X-ray, and solubility measurements in the form of tables.

The last Paper of Section II stands in a class by itself, even if only on account of its length: 52 pages, out of a total of 178 pages. "The Growth and Uses of Gem-Grade Corundum Crystals" was compiled from material left by the late S. K. Popov (1900-1953) and its compilers hope that it will preserve the memory of a talented designer and experimenter who devoted his life to synthesizing monocrystals. The first half of the Paper presents a collection of points arising in the art and craft of corundum growing, and the second half deals with the bending and flame-polishing of corundum rods in order to prepare fibre guides for use in the production of synthetic fibres. Much of the material of this Paper could form part of a manufacturing instructions manual, and the detailed description of the various types of Russian equipment should prove to be of great assistance to other workers in this field.

The review and discussion articles of Section III warrant only a brief consideration. "Dislocations in Germanium Monocrystals" is a short and incomplete survey of the literature; of the 45 references given, 40 were published in English, two in Japanese, two in Russian, and one in German. "The Main Trends in the Study of Inorganic Crystals Containing Organic Impurities"

is useful in that it deals chiefly with the effects of dyes on crystal behaviour—a field in which Soviet workers are active; 18 of the 58 references given were published in Russian. "The Theory of the Crystallisation of Steel" is a 3½ page discussion of the ideas advanced in Hvorinov's (Czech) book "Crystallisation and Inhomogeneity in Steel".

"Crystal Growth", Volume 2, is adequately bound; the Paper is good; the type is clear; and the standard of translation is uniform and exceptionally high. Line drawings are excellent, but the quality of the photographic illustrations is, at best, poor, and in some cases atrociously bad. At 128s., this is a book for a library which has a few shelves devoted to crystals and their growth.

S. E. B.

THERMOELECTRICITY

"Thermoelectric Materials and Devices." *Edited by Irving B. Cadoff and Edward Miller. Published by Reinhold Publishing Corporation, New York, and Chapman and Hall Ltd., 37 Essex Street, London, W.C.2. Pp. xiii + 344. Price 78s.*

THERMOELECTRICITY is a rapidly expanding field, stimulus for research being provided by the recent development of semi-conductors having high thermoelectric power combined with moderately low thermal conductivity and electrical resistivity. For power generators or refrigerators, the thermoelectric method is already appropriate when moving parts cannot be tolerated, but in general this process is not yet competitive with the more conventional methods. To provide a basis for future research, therefore, it is useful to have a review of the theoretical, practical and engineering knowledge available. The present book achieves this purpose.

The first four chapters deal with the theory of thermoelectric processes, an analogous treatment of thermionic conversion being included for comparison. Chapters 5-8 are concerned with the methods used for the evaluation of material parameters. An assessment is then given of the properties and potential value of bismuth and lead telluride, refractory materials, ionic materials and liquids. Finally, the principles of design and resultant performance for actual prototype thermoelectric refrigerators and generators are described.

It is regrettable that the early theoretical chapters contain a large number of printing errors, and that there is too much repetition, particularly in the sections dealing with the measurement of properties. By careful pruning the book could have been reduced to about two-thirds of its present length, without loss of clarity or information.

Following these criticisms, it is gratifying to record that the second half of the book provides an excellent review of the potential usefulness of various thermoelectric media and of actual installations. Of particular value are the descriptions of the methods used for optimizing performance in accordance with various requirements, e.g. maximum heat transfer in refrigerators, minimum volume in generators, etc.

The book will provide a useful guide for engineers and research workers but, because of errors and inadequate treatment of the theoretical sections, cannot be recommended for students.

C. A. C.

FINISHING PROCESSES

"A Practical Manual of Industrial Finishes." *By B. M. Letsky. Published by Chapman and Hall, 37 Essex Street, London, W.C.2. Pp. xii + 251. Price 35s.*

THAT only about 50 pages of this book are devoted to the surface finish of metals might appear strange to the reader, especially when the author states that £500,000,000 per year is lost by corrosion of steel in Europe alone and, to emphasize such wastage by corrosion, he mentions that at least £250,000 is lost during the life of an average tanker. However, the author makes his apology for such inadequacy, because such a manual would require several volumes.

The book is a reference book. It contains many formulae for wood finishes and non-metallic materials.

The surface finishes for metal are principally related to enamels for domestic equipment such as washing machines. Protective values of pigments receive some consideration. For transport vehicles there are some valuable formulae for primers, stoppers and finishing coatings.

Although the book is a summary of over 33 years of the author's experiences related to surface finishes, it is a simple reference book that may be very occasionally wanted in the metallurgist's library, albeit, for those engaged in surface finishes the book may be of much more value.

I. W.

STANDARD SPECIFICATIONS

White Metal Bearing Alloy Ingots (B.S.3332/1961). *Price* 5*s.*

REQUIREMENTS for nine recommended alloys — which are considered to cover the range of properties generally needed in white metal bearing alloys—are given in this Standard.

It is recognized that elements such as cadmium, nickel, silver, tellurium or arsenic are sometimes added to these alloys, but these variants have not been included in the standard because, while for particular applications improved properties are claimed, some of the resulting alloys are more difficult to use.

Methods for the Analysis of Copper Alloys: Parts 1 *to* 5 *: Copper, Lead, Iron, Aluminium and Nickel* (B.S. 1748 : 1961). *Price* 6*s.*

PUBLISHED in one volume, these five British Standard methods form part of a series of methods for the analysis of copper alloys. Three other methods have already been published (Parts 6, 7 and 8), and further methods wil be re-issued in due course.

The methods contained in Parts 1 to 5 of the standard are intended primarily for the analysis of the copper alloys included in B.S.1400, "Copper Alloy Ingots and Castings", and those being included in the series of schedules of wrought copper and copper alloys, B.S.2870 to B.S.2875, of which B.S.2871 has already been published.

Reagents are specified, together with test procedure from one sample weighing, for the determination of copper, lead, iron, aluminium and nickel, in copper alloys containing 1 to 14 per cent of tin, up to 2 per cent of nickel and small amounts of aluminium: for example, phosphor bronzes, leaded phosphor bronzes, gunmetals and leaded gunmetals. (The sampling methods recommended are those given in B.S.1499, "Sampling Non-ferrous Metals".)

While the methods may, in some cases, appear lengthy, it should be realized that they are put forward as referee methods.

Copies of the above-mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Iron in Aluminium-Magnesium-Silicon Alloys

—concluded from page 110

It would not be advisable, however, to increase the maximum iron allowed by the Standard because although an increase from 0·35 per cent to 0·45 per cent would be tolerable for door and window frames, the material would no longer be suitable for shop windows and car trim. For the latter applications, a decrease to 0·15 per cent iron by using 99·7 per cent aluminium base would be more suitable.

The authors wish to thank Prof. Carlo Panseri, Director of the Istituto Sperimentale dei Metalli Leggeri for entrusting the investigation to them and for permission to publish the results.

References

[5] UNIPREA Decorative and Protective Treatments. Anodizing Procedure for Aluminium and its Alloys. Standard 1/1.1, July, 1959.

Industrial News *Home and Overseas*

A Birmingham Meeting

At the luncheon meeting of the **Non-Ferrous Club,** held at the Queen's Hotel, Birmingham, last week, the guest speaker was Mr. R. C. Hilton, divisional traffic manager of the Western Region, British Railways, who took as the theme of his address "Social Service or Commercial Enterprise?" Mr. Hilton asked if it was fair to expect a social service and then to criticize that service for losing money? He emphasized the difficulties imposed by competition for labour, a competition in which industry had so much more to offer both in wages and conditions, and he quoted figures of staff shortages to reinforce his statement.

A collection was taken at this meeting on behalf of the Royal Metal Trades Pension and Benevolent Society, and the sum of £18 8s. 9d. was realized. The annual general meeting of the club will be held on March 23 next.

Zinc in Architecture

It is learned from the **Zinc Development Association** that the European Zinc in Architecture Committee, some members of whom were also architects, met in London last week and planned a series of bulletins reviewing new developments in zinc for roofing, gutters and rainwater pipes throughout Europe. The first number will be issued this summer in English, French, German, Italian and Dutch editions, fully illustrated and written to tell architects about new techniques in using sheet zinc.

The committee, supported by all the important European producers of sheet zinc, is also studying prefabricated roofing systems and will compile full information on the outstanding durability of zinc roofs in different environments.

Industrial Films

A revised list of films, film strips and wall charts has recently been published by the **Aluminium Development Association** covering 28 pages. This list now shows 85 of the 16 mm. sound films, of running times varying from 12 to 40 min., some being in colour. This part of the library is classified between films on production, working, joining and applications of aluminium.

There are also 35 mm. film strips, of 30-70 frames in length, dealing with various aspects of the working of aluminium such as casting, welding and press forming; there are also some on the properties of metals, and one dealing with aluminium in everyday use.

The Association has now published five charts for class use, accompanied in each case by a booklet of notes addressed primarily to the teacher but written in such a manner that they can be used by the student, independently of the chart, for private study. The subjects range from the production of aluminium, through its preparation and properties, to the production and uses of extruded sections.

Aluminium Fish Cans

According to news from Canada, **Aluminium Limited** is collaborating with Portuguese canning interests to build and operate a plant in Portugal to produce aluminium fish cans. Introduction of aluminium canning techniques to Portugal, where sardine production is a major industry, will be based on experience gained in Norway, where this type of pack was pioneered. Initially, the new canning plant will use specially anodized and lacquer-sealed aluminium strip produced by the company's affiliates in Norway or England.

The new can-making company, in which two of the principal Portuguese fish canners are participants, is called Fabrica de Emballegens de Aluminio Limitada. Its plant will be in production later this year at Matosinhos, the main centre of the fish canning industry. Capacity of the plant is expected to reach 12 million cans per year.

Malayan Tin

Tin shipments from Penang in January were 6,267¾ tons, according to the Straits Trading Company. This compared with 7,739½ tons in December and 4,924 tons in January 1960. The latest figures comprised—to the United Kingdom 280, U.K. and option Continent 50, United States 1,170, Continent 2,921½, Canada 15, Japan 1,118¼, Pacific 8, India 303, South America 223, Africa 40, Australasia 60, and the Middle East 78½.

Shipments from Singapore amounted to 27 tons, against 4½ tons in December and 5¼ tons in January 1960. The breakdown was: to the Continent 5, Pacific 10¾, India ½, South America 3, and the Middle East 7¾.

Manchester Office

A change of address for their Manchester office has been notified by **Deutsch and Brenner Ltd.** The new address is 1 Brazenose Street, Manchester 2, and the telephone number is Blackfriars 9630.

Lecture Courses

Two vacation lecture courses are announced by the **Battersea College of Technology.** The first is one on the "Fracture of Metals" and will be held from April 11 to 14 next. It is intended to give an overall picture of recent work in this field, and all the lecturers have been selected for their first-hand knowledge of the subject. The fee for the course is £10 10s. 0d., inclusive of luncheon, morning and afternoon refreshment.

The second course will deal with "Applications of Electron Diffraction", and will be held on April 13 and 14 next. This course has been arranged for users and potential users of electron diffraction techniques in science and industry. The emphasis will be on practical applications rather than theoretical aspects of the subject. In view of this, the first day of the course will be devoted to lectures and discussion, while on the second day visits will be arranged to establishments where electron diffraction apparatus is in use. The fee for the course is £5 5s. 0d. inclusive of luncheon and afternoon refreshment and transport for visits.

Complete details and enrolment forms may be obtained from the Secretary, Battersea College of Technology, London, S.W.11.

Electronic Control Equipment

An agreement has been concluded between **Lancashire Dynamo Electronic Products Ltd.** and the Emerson Electric Manufacturing Co. of St. Louis, U.S.A., under which the American company will have the right to manufacture, under licence, in the U.S.A., on a royalty basis, the complete range of industrial electronic control equipment which has been designed, manufactured and marketed over the past fifteen years by the British company. The agreement provides for a continuing flow of "know-how" to Emerson on new developments in equipment and manufacturing techniques.

Among products covered by the agreement are a complete range of specialized adjustable speed drives for all types of industrial process, regulator equipment, circular and strip chart recorders/controllers for the process industries, machine tool control systems, a wide variety of photo-electric equipment, resistance welding controls, and many other specialized devices for automatic control in industry.

Electric Furnaces

It is announced by **Royce Electric Furnaces Ltd.** that they have received orders from Associated Transistors Ltd. for nine furnaces, to be installed in the modern transistor factory being erected at Basingstoke.

The new plant will include furnaces for alloying and diffusion, and their designs will incorporate the special requirements of Associated Transistors and the latest American practice. Important features of these furnaces will be their easy-to-clean streamlined appearance, and the provision of hinged lids giving easy access to the furnace interiors without the need for dismantling.

These Royce furnaces will be controlled by proportional, stepless indicating controllers acting through magnetic amplifiers and saturable core reactors. Temperatures will be recorded on a multi-position potentiometric instrument.

New Company's Office

Following the recent formation of **Davy-Ashmore Export Company Limited,** a subsidiary of Davy-Ashmore Limited, the new company will operate from offices at 15 Portland Place, London, W.1. Telephone No. Langham 5588.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week rose 133 tons to 10,140 tons, comprising London 4,267, Liverpool 3,958 and Hull 1,915 tons. Copper stocks fell 240 tons to 15,620 and comprised London 1,250, Liverpool 11,645, Birmingham 400, Manchester 2,275, and Hull 50 tons.

Lead duty-free stocks rose 614 tons to 7,350 tons, while in-bond stocks fell 25 tons to 3,892 tons. All supplies were in London. Zinc duty-free stocks rose 313 tons to 3,115 tons while in-bond stocks fell 50 tons to 525 tons, comprising

Adjudicators at the Conversazione and Students' Evening of the Birmingham Metallurgical Society (see page 108). Left to right, Dr. W. O. Alexander, Dr. J. W. Jenkin and Mr. S. Heslop

London duty-free 1,447 tons and in-bond 525 tons, Liverpool duty-free 1,623 tons, and Glasgow duty-free 45 tons.

Furniture Design

It is proposed by the **British Aluminium Company Limited** to launch a furniture design competition in the Spring, in collaboration with the Council of Industrial Design, in order to encourage designers and manufacturers to continue to exploit the potentialities of this versatile metal.

At the International Hardware Trades Fair, which opened at Olympia on Monday last, the company features a representative collection of modern aluminium furniture for the garden. The exhibits range from swings and sun beds, and picnic chairs and tables, to trays and trolleys. Most of the pieces on display can be quickly and easily folded, and all of them are extremely light.

Lead-Plywood Panels

New X-ray resistant doors, partitions and wall panels have recently been fitted in the radiography departments of Queen Mary's and Plaistow hospitals in East London. They are made from Lead Plymax, a composite material of sheet lead faced with plywood, and are said to be the first of a series of similar installations to be made in all the six hospitals governed by the West Ham Group Hospital Management Committee.

This Plymax material, made by **Venesta Plywood Ltd.**, consists of sheet lead 1½ mm. thick, faced on both sides with, for the panelling, ¼ in. plywood and, for the doors, ⅛ in. plywood. It is considered that this material will prove considerably more durable, and the panels have the great advantage of being easily movable.

Metallurgical Symposia

Two one-day Symposia are to be held in the Summer Term of the 1960/61 session by the **Borough Polytechnic**, Borough Road, S.E.1. The first, to be held on Thursday, April 20, 1961, morning and afternoon, deals with "Welding of Rarer Metals", including: electron beam welding, welding of beryllium, welding of uranium, welding of titanium, welding of Zircaloy 2, and the welding of tantalum, niobium, molybdenum and tungsten.

The second, on Thursday, July 6, 1961, morning and afternoon, will be concerned with "Internal Stresses in Electrolytically Produced Coatings, and their Effects on the Properties of the Basis Metals", and among the subjects for discussion will be the following: internal stresses and their measurement, internal stresses in hard chromium and heavy nickel deposits, internal stresses in bright nickel deposits, internal stresses in rhodium and platinum metal deposits, and internal stresses in electroforming and electrotyping.

Welding in Shipbuilding

Offers of Papers for the 1961 Symposium on Welding in Shipbuilding are still being considered, and should be accompanied by a synopsis of not more than 100 words indicating the scope of the Paper proposed.

The Joint Symposium on Welding in Shipbuilding will be held in London in October/November, 1961, and will be sponsored by the Institute of Welding, the Royal Institution of Naval Architects, the North East Coast Institution of Engineers and Shipbuilders, and the Institution of Engineers and Shipbuilders in Scotland. Eighteen offers of Papers have already been accepted covering many aspects of the design of welded hulls, including the use of high yield point steels; aspects of construction, including a number on shipyard layout and the handling of materials, with others on the welding of the aluminium alloys; as well as Papers on the non-destructive testing of welded joints and on the training and testing of ship welders.

Aluminium in Ice Making

In an ice-making plant and an ice-conveying system recently completed for the Grimsby Ice Company Ltd., wide use of aluminium has been made. In the ice-making plant, large blocks of ice are slid across a floor covered with Noral 65SWP aluminium alloy sheet, which provides an admirable low-friction surface. The new conveyor system is an extensive installation which receives the large blocks of ice from the plant, crushes them, and then delivers the crushed ice direct into the holds of trawlers at the dockside.

There are four icing points, each consisting of a telescopic chute which can be swivelled and is adjustable for length. The chute is of 14 S.W.G. sheet in Noral 65SW aluminium alloy; it has a diameter of 1 ft., is 62 ft. long when fully extended and 34 ft. long when fully closed.

About four tons of Noral B51S and 65S aluminium alloy plate and sheet, and 1¼ tons of 20 S.W.G. 3 in. corrugated sheet were used in the construction of the chutes, hoppers and external gantries. Aluminium was used in the conveyor system since it was found, it is said, to be more durable and less liable to denting than the galvanized steel formerly used. The lighter weight of the aluminium is also an advantage in the telescopic chutes, which must be easily manoeuvrable.

Telephone Number Changed

The telephone number for the Extrusion Division of **High Duty Alloys Ltd.** at Distington, is now Workington 2581-6.

British Firms at Moscow Fair

At the British Trade Fair, Moscow, 1961, the **Morgan Crucible Group** will be represented by a new subsidiary company — Morganite Exports Ltd. The three main exhibits displayed will be "Purox" refractories, "Crusilite" heating elements, "Morganite" and "Morganohm" resistors.

On the Desoutter stand will be shown a complete range of 150 portable pneumatic power tools. These will include drills, screwdrivers, nutrunners, grinders, nibblers and shears, and various stands for bench mounting.

Several consignments of multiple tools have already been made to Russia.

B.I.S.R.A. "Open Days"

Preliminary notice is being given of two "Open Days" which the British Iron and Steel Research Association will hold at its Sheffield laboratories on Thursday and Friday, June 15 and 16, 1961.

The Hoyle Street premises house three of B.I.S.R.A.'s five main divisions—steelmaking, metallurgy (general) and the mechanical working division. In addition, the steel user section, which operates an important advisory service to industry generally, is also housed there.

Among the many displays and demonstrations planned by the steelmaking division will be the latest developments in continuous casting, and work on spray refining and rapid de-sulphurization. One of the mechanical working division's projects on show will be a recently-developed rapid annealing system. Prominent among the metallurgy division's projects will be aspects of its general pre-occupation with the purification of steel (jet de-gassing, vacuum casting, etc.), work on improved speed and accuracy in analysis, and the production of high-temperature steels. All these examples are arbitrarily selected, and represent only a few of the many projects which will be on show.

Canadian Metal Production

Production figures for November have been issued by the Dominion Bureau of Statistics in Ottawa (all in tons except silver, which is in ounces). Figures for 1959 are given in parentheses. Copper 38,068 (34,907); nickel 17,679 (16,916); lead 17,192 (13,495); zinc 34,845 (30,665); silver, 3,086,228 (2,334,137). For January/November 1960, the figures were: copper 406,557 (361,096); nickel 195,559 (167,844); lead 184,702 (172,166); zinc 378,302 (363,191); silver 30,276,176 (29,249,431).

Electrical Engineers' Exhibition

At the A.S.E.E. Exhibition, which opens on March 21 at Earls Court, the **London Electric Wire Co. and Smiths Limited**, together with its associate companies, will display comprehensive ranges of their manufactures on Stand L.5.

The L.E.W. display Lewcos insulated wires and strips, including Lewmex, Lewcoglass, Lewkanex, Lewcosol, and

Lewbestos conductors; samples of transposed strip and a sample range of superfine self-fluxing wires.

Frederick Smith and Co. exhibit "Anacos" bare copper and copper alloy rods, bars, wires, strands, strips and sections; "Salcos" aluminium wires and strands.

The Vactite Wire Co. Ltd. show resistance wires and tapes in Vacrom (nickel-chrome) and Eureka (cupro-nickel), molybdenum rods, wires and tapes, and nickel and Monel wires and tapes.

Millett Levens (Engravers) Ltd. display self-adhesive and conventional industrial nameplates, dials and scales in all metals and plastics. Printed Circuits Ltd. exhibit "Plasmet" copper etched wiring circuits (single- and double-sided, flexible and rigid), strain gauges, cable forms, heating elements, code discs; printed circuits for radio and television receivers, and for industrial applications.

Process Selection

An addendum to the **Aluminium Development Association's** bulletin No. 19 ("The Arc Welding of Aluminium") has recently been published. This addendum has been occasioned by the continuing development work in the arc welding of aluminium, and should be taken as an amplification of the relevant paragraphs in the bulletin.

The addendum consists of two parts, the first giving further guidance on the choice of welding processes and the second dealing with the appropriate filler or electrode for welding pure aluminium to one of its alloys or to dissimilar alloys; also for the welding of wrought to cast aluminium.

Packaged Boilers

What is stated to be the largest single packaged boiler installation in this country has just been completed by **G.W.B. Furnaces Ltd.**, and is part of a multi-million pound project being carried out by Henry Wiggin and Company Ltd. at their Hereford works, where five model 600 Powermaster packaged boilers have recently been put into service.

The new boilers will be mainly used for space heating, though some steam will be raised for process work. Designed to run on 3,500 sec. fuel oil, and also C.T.F.200, without any modifications whatsoever, the five Powermasters will be capable of producing 105,000 lb. of steam an hour. It is only during the winter months that all five boilers will be working simultaneously. All the boilers are 22 ft. 10 in. long, 9 ft. wide, and stand 14 ft. high. Each weighs 58,000 lb.

Export Order

An order from their New Zealand agents, Weldwell (New Zealand) Ltd. for 3,000 of their tip cleaner sets has been received by **Weldcraft Ltd.**, of Slough (one of the G. B. Peters group). The sets comprise 12 nozzle cleaners for cleaning the orifices in welding nozzles and maintaining a flame free of distortion. They can be produced to order for all sizes and types of blowpipes. Although credit restrictions are in force in New Zealand, there was no difficulty in obtaining import sanction.

Industrial Films at Moscow

The cinema at the British Trade Fair in Moscow, May 19-June 4, seats 500, and bookings can now be accepted by Pearl and Dean (International) Ltd., of 33 Dover Street, London, W.1, who have been appointed sole concessionaires for the exhibition cinema, for documentaries of a minimum length of 5 min., as well as for shorter length "commercials". Films can be shown with an English commentary, but a Russian commentary can be arranged, as well as an end trailer for the film in Russian, giving details of the exhibition stand.

The cinema is open from 9 a.m. to 9 p.m. each day, including Sundays, and reports from previous exhibitions confirm that it is one of the main attractions of all trade fairs held to date at the Sokolniki Park in Moscow.

British Tools at German Fair

At the forthcoming Leipzig Fair, **Dowding and Doll Ltd.** are sending their new Accuratool automatic lathe, of $\frac{13}{16}$ in. (20·6 mm.) bar capacity. The company are also showing an entirely new high-speed hydraulic press, the "R.G.", a machine for blanking out shapes or piercing holes. There will also be two models of the British Wiedemann turret punch press, model RA.41P operated by a stylus moving over a pantograph table, and model R.44 with rack gauge table.

About 20 countries are showing a comprehensive range of machine tool equipment. East Germany, among other products, will display newly designed plastics processing machines. The Soviet Union and China are to show heavy turning lathes and high precision modern drilling machines.

About 200 British firms will be represented at the ten-day Fair.

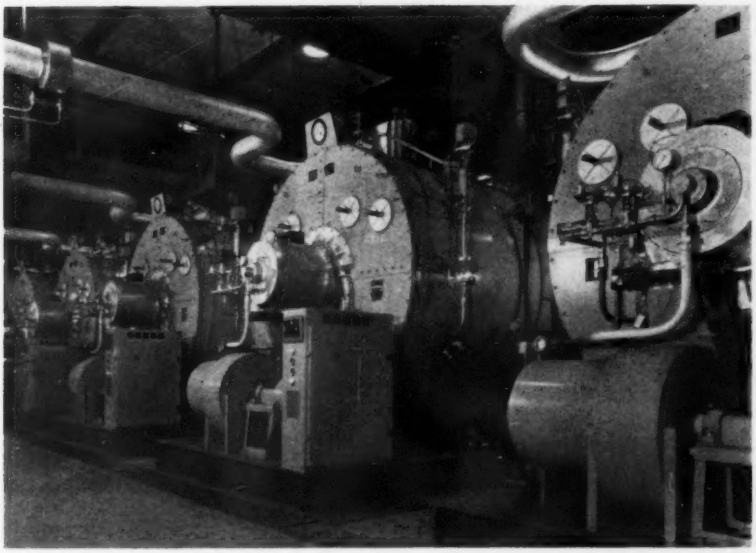
U.S. Lead Production

Recoverable lead production reached 19,200 tons in the U.S. in December, 1960, according to the Bureau of Mines, United States Department of the Interior.

The December output represented an increase of about 1,000 tons over the two preceding months' output, and was accounted for mainly by the larger production reported from Colorado.

The cumulative January - December monthly production total of 244,000 tons for 1960 represented a decline of 5 per cent from the 255,600 tons reported in 1959. The decline was attributed largely to the strike in the Coeur d'Alene region of Idaho, which reduced output about 2,000 tons a month from June until December.

Capable of producing 105,000 lb. of steam an hour, these five Powermaster boilers at the Hereford works of Henry Wiggin and Co. Ltd. form the largest single packaged boiler installation in the country



Forthcoming Meetings

February 13—Institute of Metals. Scottish Local Section. Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow. "Beryllium as a Structural Material." Dr. A. J. Martin. 6 p.m.

February 14 — Institution of Works Managers. Birmingham Branch. College of Technology, Gosta Green, Birmingham. A series of three short films. 7 p.m.

February 14 — Institute of British Foundrymen. Slough Section. Lecture Theatre, High Duty Alloys Ltd., Slough. "Developments in Melting and Casting." W. W. Glick. 7.30 p.m.

February 14 — Society of Chemical Industry. Corrosion Group. 14 Belgrave Square, London, S.W.1. "The Occurrence of Fire-side Corrosion in Modern Steam Generators." W. D. Jarvis. 6 p.m.

February 15 — Institution of Plant Engineers. Kent Branch. Queen's Head Hotel, Maidstone. "Smut Emission from Oil Fired Boilers." P. Hawkesfield. 7 p.m.

February 16—Institute of Metals. Birmingham Local Section. College of Technology, Gosta Green, Birmingham. "The Growth and Prospects of the Aluminium Industry." G. W. Lacey. 6.30 p.m.

February 16 — North East Metallurgical Society. Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough. "Plastics versus Metals." Dr. P. T. Moore. 7.30 p.m.

February 16 — Institution of Production Engineers. Southern Region. The Blue Room, Reading Co-operative Society Ltd., Cheapside, Reading. "Precision Investment Casting." P. G. Chapman. 7.30 p.m.

Metal Market News

SOME details relating to non-ferrous activity in December were released last week by the British Bureau of Non-Ferrous Metal Statistics and, as might be expected, owing to the Christmas holiday, these show some falling off in comparison with November. The setback in copper is, however, very marked, but it must be remembered that for some reason the November total consumption was exceptionally high. Actually, the figures were 56,279 tons consumed in December, compared with 68,168 tons in November, a drop of nearly 12,000 tons. There was a drop of about 10,000 tons in the usage of refined copper to 43,311 tons, and of nearly 2,000 tons in secondary to 12,968 tons. Stocks of copper, blister and refined, showed a decline of less than 1,000 tons to 114,452 tons. In lead, consumption of primary and secondary amounted to 30,148 tons, against 33,661 tons in November, and stocks at 70,853 tons were up by 6,500 tons. In tin, the usage in December was 1,588 tons, compared with 2,164 tons in the previous month, while stocks were up by about 400 tons, at 11,778 tons. The increase of 6,500 tons in stocks of lead is, of course, in line with the depressed price, which results from over-supply, with little prospect of any adjustment for some time to come. Metal Exchange warehouse stocks of zinc have been on the increase, and a similar trouble to that affecting lead, viz. an excess of production over consumption, appears to be upsetting the zinc quotation.

Trading in Whittington Avenue last week was active, and the turnovers on the whole satisfactory. For example, in copper some 12,000 tons changed hands, apart from Kerb transactions, and the trend was firm although the increase in values was not spectacular. At the close, cash was quoted at £219 10s. 0d., a gain of £1 15s. 0d., while three months stood at £220 15s. 0d., which was £2 5s. 0d. up. The contango narrowed to 25s. Warehouse stocks registered an increase of 540 tons to 15,860 tons. Nothing spectacular occurred during the week's trading, but the President's speech was interpreted as a bull factor, and the market scored a modest advance on the strength of it. Then, a couple of days later, a request was made to the White House to take the initiative in securing a stable world price for copper. This seems to have been hailed as a bull point, for the price of the metal; just why, it is hard to say. However, it is doubtful whether anybody takes the idea very seriously, for this matter of price stability has been up for discussion so often that it is really getting rather threadbare. Consumer demand for copper does not seem to be altogether satisfactory, but, nevertheless, the quotation on the standard market is very firm.

Dealers in tin were kept fairly busy, and the turnover for the week amounted to 1,280 tons. Warehouse stocks were down by 33 tons to 10,007 tons, and the market was firm, with both cash and three months 30s. up at £788 10s. 0d. and £790 10s. 0d. for the respective positions. Trade demand seems to be fairly good. In lead, an increase in warehouse stocks of 89 tons to 10,653 tons was reported, and the market rallied by 15s. in both positions to £64 10s. 0d. cash and £65 12s. 6d. three months. The turnover was 8,500 tons. Zinc followed a similar course, cash gaining 7s. 6d. to £79 7s. 6d., and three months 5s. to £79 2s. 6d. The turnover was 6,275 tons. Metal Exchange warehouse stocks appreciated by 698 tons to 3,377 tons.

Birmingham

Little change has taken place in the industrial position in the Midlands. There is a ray of hope in the motor trade in that at one of the big car factories an extra shift has been started this week, but industrialists are very cautious as to the outlook, and the move is not regarded as an indication of the turning of the tide. It is noteworthy, however, that while the recession in the car trade continues, there is continuous work at the works making tractors. A local firm has recently booked a valuable contract from East Germany. Firms manufacturing metal components for the building industry continue well employed, but there is only a moderate business in household appliances.

Steelmakers have been obliged to reduce output of sheets. Users have stocks which will last for some time, and there is no inclination to place new contracts. There is less pressure for supplies of re-rolled steel, and there is no shortage of billets and sheet bars. The building industry maintains its demand for reinforcing bars and heavy structural steel, such as joists and sections. Working hours were cut at foundries at the beginning of the year, and orders in hand are not enough to warrant a return to normal. Ample supplies of pig-iron are available as far as foundry grades are concerned.

New York

Copper futures, at the week-end, after early softness, firmed on covering and new buying in thin dealings. Traders were not able to pin down the reason for the buying, but believed it might be linked with the Senator Mansfield proposal for an international copper meeting to stabilize the copper industry. Physical copper was generally quiet, with the undertone steady. Scrap copper was up another ¼ cent/lb. to 23 cents. Tin was quiet, with the undertone softer, although nominally prices held unchanged. One leading source said with buying interest so inactive, lowering the price might not stimulate any business. Lead and zinc were moderately active.

International control of copper production, similar to that for tin, was urged in Detroit by Mr. Milton Schwab, of Franklin Smelting and Refining Company. Speaking at the Midwest regional meeting of the National Association of Secondary Material Industries, Mr. Schwab said that producers' "hesitant attempts at curtailing production have been fairly ineffectual thus far". Such cutbacks "are usually surrounded by a secrecy that creates resentment in the minds of the consumers".

Mr. Schwab said that in tin, the International Buffer Pool, with the U.S. as an observer, functioned very effectively. He added that "it certainly behoves the copper group to set up a plan that will help the industry in its competitive struggle rather than harm it, and will draw consumers to the usage of copper rather than repel them".

Zurich

During the end of January, business revived slightly on the Swiss non-ferrous metals market. According to trade quarters demand for all metals is fairly uniform, and limited almost exclusively to current requirements. In view of uncertainties about future price trends users are cautious but traders expect a seasonal increase in demand in the near future.

Swiss imports of non-ferrous metals in December and November (in brackets) were the following, according to figures issued by the Customs Directorate (in metric tons): copper 3,855 (5,109), nickel 96 (133), aluminium 710 (1,219), crude lead 2,196 (1,377), crude zinc 3,134 (2,113), crude tin 160 (59).

India

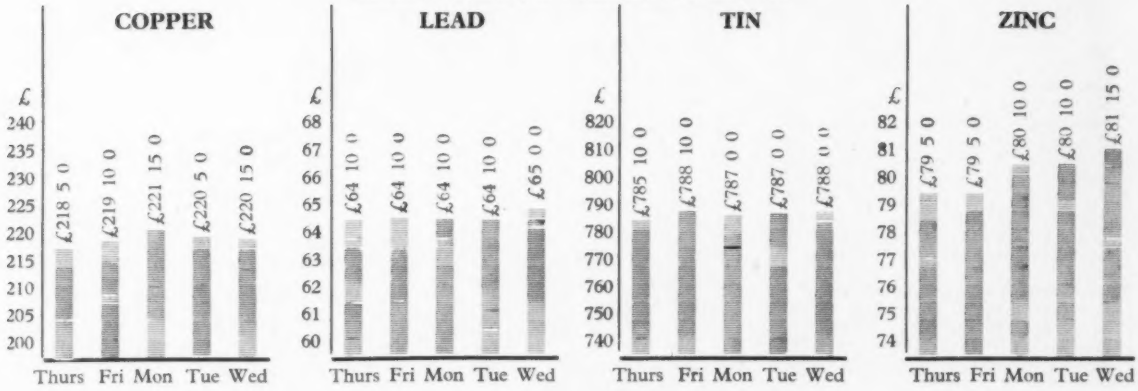
According to figures compiled by trade sources in Calcutta, India imported a total of 51,780 tons of virgin copper during 1960, as against 45,430 tons in the previous year. The quantity of zinc imported during the year amounted to 61,146, tons against 47,100 tons in 1959, while lead and tin imports were 21,752 tons and 3,257 tons respectively, against 23,612 tons and 4,404 tons.

These figures compare with the total estimated requirement of the country for the year 1960/61 of 85,000 tons each of copper and zinc, 35,000 tons of lead and 7,000 tons of tin.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 2 February to Wednesday 8 February 1961



Primary Metals

All prices quoted are those available at 2 p.m. 8/2/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	,,	217	10	0
Antimony Metal 99%	,,	210	0	0
Antimony Oxide Commercial	,,	194	10	0
Antimony White Oxide	,,	196	0	0
Arsenic	,,	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	,,		11	0
Calcium	,,	2	0	0
Cerium 99%	,,	15	0	0
Chromium	,,		6	11
Cobalt	,,		12	0
Columbite	per unit		—	
Copper H.C. Electro	ton	220	15	0
Fire Refined 99·70%	,,	219	0	0
Fire Refined 99·50%	,,	218	0	0

		£	s.	d.
Copper Sulphate	ton	76	0	0
Germanium	grm.		—	
Gold	oz.	12	11	3
Indium	,,		10	0
Iridium	,,	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	65	0	0
Magnesium Ingots	lb.			
99·8%	,,		2	2½
99·9+%	,,		2	3
Notched Bar	,,		2	9½
Powder Grade 4	,,		6	1
Alloy Ingot, AZ91X		1	11¾-2	1¼
Manganese Metal	ton		—	
Mercury	flask	69	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	,,		5	6
Osmium	oz.		nom.	
Osmiridium	,,		nom.	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	,,	30	5	0
Rhodium	,,	46	0	0
Ruthenium	,,	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	7⅜
Tellurium Sticks	lb.	2	0	0
Tin	ton	788	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	,,		—	
Virgin Min 98%	,,	81	2	6
Dust 95/97%	,,	128	0	0
Dust 98/99%	,,	134	0	0
Granulated 99+%	,,	106	2	6
Granulated 99·99+%	,,	121	12	6

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg≏£/ton		**Canada** c/lb≏£/ton		**France** fr/kg≏£/ton		**Italy** lire/kg≏£/ton		**Switzerland** fr/kg≏£/ton		**United States** c/lb≏£/ton	
Aluminium			26.00	215 16	2.43	179 11	370	216 1	2.50	206 5	26.00	207 4
Antimony 99.0					2.30	170 0	495	286 3			29.00	231 2
Cadmium					15.75	1,069 0					150.00	1,195 10
Copper												
Crude												
Wire bars 99.9							420	245 5				
Electrolytic	30.25	223 11	27.50	222 15	3 06	226 2			2.83	231 0	29.00	231 6
Lead			10.00	81 0	.94	69 9	163	95 3	.83	68 9	11.00	87 13
Magnesium												
Nickel			70.00	581 0	9.00	665 2	1,200	699 6	7.50	618 15	74.00	589 15
Tin	109.00	796 13			11.14	823 4	1,480	864 6	9.58	805 12	100.62	801 18
Zinc												
Prime western			12.00	99 12 0								
High grade 99.95			12.60	104 11 0								
High grade 99.99			13.00	107 18 0					1.10	92 10		
Thermic					1.20	88 13						
Electrolytic					1.28	94 13	181	105 14			13.00	104 0

C

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 8 2 61

	£	s.	d.
Aluminium Alloy (Virgin)			
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10.... „	221	0	0
B.S. 1490 L.M.11.... „	215	0	0
B.S. 1490 L.M.12.... „	223	0	0
B.S. 1490 L.M.13.... „	216	0	0
B.S. 1490 L.M.14.... „	224	0	0
B.S. 1490 L.M.15.... „	210	0	0
B.S. 1490 L.M.16.... „	206	0	0
B.S. 1490 L.M.18.... „	203	0	0
B.S. 1490 L.M.22.... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	171	0	0
B.S. 1490 L.M.2 .... „	174	0	0
B.S. 1490 L.M.4 .... „	183	0	0
B.S. 1490 L.M.6 .... „	183	0	0
***Aluminium Bronze**			
BSS 1400 AB.1..... ton	242	0	0
BSS 1400 AB.2..... „	250	0	0

	£	s.	d.
***Brass**			
BSS 1400-B3 65/35 .. ton	173	0	0
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „	218	0	0
***Gunmetal**			
R.C.H. 3/4% ton .... „		—	
(85/5/5/5) LG2 ..... „	215	0	0
(86/7/5/2) LG3 ..... „	224	0	0
(88/10/2/1) ..... „	278	0	0
(88/10/2/½) ..... „	288	0	0
***Manganese Bronze**			
BSS 1400 HTB1..... „	193	0	0
BSS 1400 HTB2..... „	210	0	0
BSS 1400 HTB3..... „	229	0	0
Nickel Silver			
Casting Quality 12% „	247	0	0
„ „ 16% „	268	0	0
„ „ 18% „	298	0	0
***Phosphor Bronze**			
B.S.1400P.B.1.(A.I.D. released) ..... „	305	0	0
B.S. 1400 L.P.B.1 „	236	0	0

**Average prices for the last week-end.*

	£	s.	d.
Phosphor Copper			
10% ..... ton	250	0	0
15% ..... „	253	0	0
Phosphor Tin			
5% ..... „		—	
Silicon Bronze			
BSS 1400-SB1 ..... „	280	0	0
Solder, soft, BSS 219			
Grade C Tinmans ... „	363	0	0
Grade D Plumbers .. „	290	10	0
Grade M ..... „	399	5	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „ „		—	
Zinc Alloys			
BSS 1004 Alloy A .. ton	115	2	6
BSS 1004 Alloy B.... „	119	2	6
Sodium-Zinc ..... lb.		2	7

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			
Sheet 10 S.W.G. lb.	2	10½	
Sheet 18 S.W.G. „	3	0½	
Sheet 24 S.W.G. „	3	3½	
Strip 10 S.W.G. „	2	10½	
Strip 18 S.W.G. „	2	11½	
Strip 24 S.W.G. „	3	1	
Circles 22 S.W.G. „	3	4½	
Circles 18 S.W.G. „	3	3½	
Circles 12 S.W.G. „	3	2½	
Plate as rolled ..... „	2	10	
Sections ..... „	3	4	
Wire 10 S.W.G. .... „	3	1½	
Tubes 1 in o.d. 16 S.W.G. ..... „	4	4	
Aluminium Alloys			
BS1470. HS19W.			
Sheet 10 S.W.G. „	3	3	
Sheet 18 S.W.G. „	3	5½	
Sheet 24 S.W.G. „	4	1	
Strip 10 S.W.G. „	3	3	
Strip 18 S.W.G. „	3	4½	
Strip 24 S.W.G. „	4	0½	
BS1477. HP30M.			
Plate as rolled ..... „	3	1	
BS1470. HC15WP.			
Sheet 10 S.W.G. „	4	3	
Sheet 18 S.W.G. „	4	8½	
Sheet 24 S.W.G. „	5	8½	
Strip 10 S.W.G. „	4	4	
Strip 18 S.W.G. „	4	8½	
Strip 24 S.W.G. „	5	4½	
BS1477. HPC15WP.			
Plate heat treated ... „	3	10½	
BS1475. HG19W.			
Wire 10 S.W.G. „	4	2	
BS1471. HT19WP.			
Tubes 1 in. o.d. 16 S.W.G. ..... „	5	5	
BS1476. HE19WP.			
Sections ..... „	3	4	
Split tube			
19 S.W.G. (⅛") ..... „	4	2	
20 S.W.G. (⅛") ..... „	3	11	
21 S.W.G. (⅛") ..... „	4	1	
22 S.W.G. (⅛") ..... „	4	11	
Welded tube			
14 to 20 S.W.G. (sizes ⅛" to 1½") .... „	3/10½ to 5/8½		

Brass			
Tubes ..... lb.		1	9
Brazed Tubes ..... „		3	2
Drawn Strip Sections „		3	1½
Sheet ..... ton	194	0	0
Strip ..... „	194	0	0
Extruded Bar ..... lb.		1	11¾
Condenser Plate (Yellow Metal)..... ton	179	0	0
Condenser Plate (Naval Brass) ..... „	191	0	0
Wire ..... lb.		2	7½
Beryllium Copper			
Strip ..... „	1	4	11
Rod ..... „	1	1	6
Wire ..... „	1	4	9
Copper			
Tubes ..... lb.		2	1¾
Sheet ..... ton	255	5	0
Strip ..... „	255	5	0
H.C. Wire ..... „	271	5	0
Cupro Nickel			
Tubes 70/30 ..... lb.		3	5½

Lead			
Pipes (London) ..... ton	104	0	0
Sheet (London) ..... „	101	15	0
Tellurium Lead ..... „	£6 extra		
Nickel Silver			
Sheet and Strip 10%.. lb.		3	9¾
Wire 10% ..... „		4	2¾
Phosphor Bronze			
Wire ..... „		4	0¾
Titanium (1,000 lb. lots)			
Billet 4½" to 18" dia..... lb.	47/-		48/-
Rod ½" to 4" dia..... „	85/-		53/-
Wire ·036"-232" dia..... „	159/-		99/-
Strip ·001" to ·048"..... „	350/-		68/-
Sheet 8' × 2'. 20 gauge „	73/-		
Tube, representative average gauge ..... „	198/-		
Extrusions ..... „	90/-		
Zinc			
Sheet ..... ton	115	10	0
Strip ..... „	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 7/2/61.

	£
Aluminium	
New Cuttings	139
Old Rolled	110
Segregated Turnings	74
Brass	
Cuttings	157
Rod Ends	140
Heavy Yellow	130
Light	125
Rolled	144
Collected Scrap	129
Turnings	133
Copper	
Wire	201
Firebox, cut up	198
Heavy	196
Light	193
Cuttings	203
Turnings	180
Braziery	175

	£
Gunmetal	
Gear Wheels	190
Admiralty	190
Commercial	178
Turnings	173
Lead	
Scrap	57
Nickel	
Cuttings	—
Anodes	555
Phosphor Bronze	
Scrap	178
Turnings	173
Zinc	
Remelted	71
Cuttings	59
Old Zinc	38

Financial News

M. L. Alkan Ltd.

Net profit, year to September 30, 1960, £53,032 (£27,324). Dividend 22½ per cent (15 per cent). Current assets £245,591 (£164,791), and liabilities £92,385 (£60,582).

An Acquisition

It was announced in Buenos Aires last week that Aluminium Limited and Antonio Vernocchi S.A., of El Palomar, Buenos Aires, had reached agreement for the purchase by Aluminium Limited of a majority interest in the Vernocchi company. Antonio Vernocchi S.A. has been a manufacturer of aluminium foil since the early 1930's.

British Aluminium/Reynolds T.I.

A 70 per cent increase in combined income for the British Aluminium Company (B.A.) Limited and Reynolds T.I. Aluminium Limited, was announced by Mr. R. S. Reynolds Jr., President, Reynolds Metals Company. Earnings before taxes for the year ending July 31, 1960, were $11,900,000, for the two firms, compared with approximately $7,000,000 a year ago.

Actual figures for the combined earnings in 1959 were not available, Mr. Reynolds explained, due to a change in its fiscal year by British Aluminium. This company shifted, on January 1, 1959, to a fiscal year beginning August 1, Mr. Reynolds said, and its share of the combined earnings is based on actual figures for the first seven months of 1959 "annualized" for a full twelve month period.

While the B.A. subsidiary, Canadian British Aluminium Company Limited, showed a loss for the fiscal year, the company had been operating at a small profit for the first three months of its current year, Mr. Reynolds stated.

Reynolds and Tube Investments Limited hold 96 per cent of the B.A. common stock, of which Reynolds controls 49 per cent of the holding and Tube Investments 51 per cent. Reynolds-T.I. Aluminium is owned 51 per cent by Tube Investments and 49 per cent by Reynolds Metals Company.

Incandescent Heat Company

It is announced that Wellman Smith Owen Engineering Corporation is making an offer for the 824,895 Ordinary 4s. units of the Incandescent Heat Company on the basis of one Wellman 5s. Ordinary plus 84s. cash for every four Incandescent units, or a straight cash offer of 129s. for every four units.

The merger will broaden the field of activities of both companies and enable them to offer the combined technical research, development and manufacturing facilities of the new group throughout the entire field of furnace design and construction. It is understood that the Incandescent group would continue to operate as an autonomous unit.

Rhodesian Selection Trust

Estimated pre-tax profit of Rhodesian Selection Trust for the quarter ended December 31 last was £1,083,000 against £1,636,000 for the previous quarter, it was announced by the company last week. This makes £2,719,000 for the first six months of the financial year against £3,014,000 for the comparable period of the previous year. Copper production of R.S.T.'s subsidiary, Mufulira, was 24,400 tons in the quarter ended December, against 27,838 in the previous quarter, while sales totalled 24,593 tons, against 26,897 tons. Output of R.S.T.'s other subsidiary, Chibuluma, totalled 4,239 tons of copper against 5,121 tons in the previous quarter, while sales totalled 4,452 tons, against 4,874 tons.

Estimated pre-tax profits of Roan Antelope copper mines for the quarter ended December 31, 1960, totalled £1,071,000, against £1,507,000 in the previous quarter, making £2,578,000 for the first six months of the financial year, against £2,785,000 for the comparable period of the previous year, the company announced. Copper production in the December quarter totalled 19,754 tons, against 22,019 in the previous quarter, while copper sales amounted to 19,784 tons, against 21,734 tons.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (new francs per kilo):

Electrolytic copper scrap	(£218.0.0) 2.95
Heavy copper	(£218.0.0) 2.95
No. 1 copper wire	(£206.18.0) 2.80
Brass rod ends	(£160.7.0) 2.17
Zinc castings	(£63.11.0) 0.86
Lead	(£61.6.0) 0.83
Aluminium	(£136.14.0) 1.85

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£178.2.0) 305
Lead, soft, first quality	(£79.8.0) 136
Lead, battery plates	(£43.16.0) 75
Copper, first grade	(£207.6.0) 355
Bronze, commercial gunmetal	(£169.1.0) 290
Brass, heavy	(£140.3.0) 240
Brass, light	(£125.11.0) 215
Brass, bar turnings	(£143.1.0) 245
Old zinc	(£57.4.0) 98

Japan (Yen per metric ton):

Electrolytic copper	(£—)	273,000
Copper wire No. 1	(£—)	253,000
Copper wire No. 2	(£—)	234,000
Heavy copper	(£—)	243,000
Light copper	(£—)	203,000
Brass, new cuttings	(£—)	185,000
Red brass scrap	(£—)	212,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£195.1.0) 225
Heavy copper	(£190.14.0) 220
Light copper	(£173.8.0) 200
Heavy brass	(£125.14.0) 145
Light brass	(£86.14.0) 105
Soft lead scrap	(£50.5.0) 58
Zinc scrap	(£47.13.0) 55
Used aluminium unsorted	(£78.1.0) 90

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Parmick Engineering Limited (680666), Woden Factory Centre, Holyhead Road, Wednesbury. Registered January 16, 1961. To take over the business of the production of automatic components, press work, steel stockists, production of hardware and plastics articles and factoring the same, metallurgical and ancillary treatments carried on at Castle Street, Hill Top, West Bromwich, by N. H. and M. C. Parr, etc. Nominal capital, £3,000 in 2s. shares (10,000 employees). Directors: Kathleen M. Parr, Michael C. Parr and Winifred Shaw.

Tyneside Metal Spraying and Engineering Company Limited (680686), Mechanic's Workshop, Blaydon Burn, Blaydon, Co. Durham. Registered January 16, 1961. Nominal capital, £1,200 in £1 shares. Directors: Robert J. Perry and Mrs. Josephine Perry.

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Oct. 1960, have been issued by the Ministry of Supply as follows (in long tons):—

Virgin Aluminium	
Production	2,037
Imports	19,896
Despatches to consumers	25,319
Secondary Aluminium	
Production	9,586
Virgin content of above	845
Despatches (including virgin content)	9,690
Scrap	
Arisings	13,152
Estimated quantity of metal recoverable	9,512
Consumption by:	
(a) Secondary smelters	11,546
(b) Other uses	1,493
Despatches of wrought and cast products	
Sheet, strip and circles	14,921
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	4,231
(b) Tubes (i) extruded	406
(ii) cold drawn	770
(iii) formed strip	—
(c) (i) Wire	1,447
(ii) Hot rolled rod (not included in (c) (i)	63
Forgings	321
Castings: (a) Sand	1,828
(b) Gravity die	4,829
(c) Pressure die	2,032
Foil	2,313
Paste	274
Magnesium Fabrication	
Sheet and strip	10
Extrusions	97
Castings	201
Forgings	15

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Good Deal Of Activity And Prices Supported

ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 6 FEBRUARY	+ RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1960-61 HIGH	1960-61 LOW	1959 HIGH	1959 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation	29/9	+ 6d.	11	9	7 13 0	34/9	25/6	33/3	23/3
400,000	2/-	Anti-Attrition Metal	1/3		NIL	4	NIL	1/6	0/9	1/7½	1/-
41,303,829	Stk. (£1)	Associated Electrical Industries	41/3	—3d.	15	15	7 5 6	67/3	39/3	67/-	54/-
3,236,424	1	Birfield	51/9	+ 4/3	10	15‡	3 17 3	52/-	29/-	75/4½	46/-
4,795,000	1	Birmid Industries	73/-	+ 1/-	20	20D	5 9 6	73/3	56/-	75/6	46/9
5,630,344	Stk. (10/-)	Birmingham Small Arms	23/9	—3d.	17½QT	12½	4 0 3	30/4½	18/4½	69/-	36/-
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/10½		5	5	6 12 3	17/4½	14/10½	17/6	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/4½		6	6	6 17 3	20/-	17/1½	20/1½	17/9
500,000	1	Bolton (Thos.) & Sons	42/6	+ 1/3	10	10	4 14 0	42/3	37/-	47/-	27/6
300,000	1	Ditto Pref. 5%	14/-	—3d.	5	5	7 2 9	16/-	13/6	16/-	14/9
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6%	17/6		6	6	6 17 3	21/1½	17/3	21/6	18/9
18,846,647	Stk. (£1)	British Insulated Callender's Cables	56/6	—6d.	13½	13½	4 15 6	61/-	47/6	61/-	45/1½
17,047,166	5/-	British Oxygen Co. Ltd., Ord.	27/3	—3d.	16	16	2 18 9	34/6	19/6	87/9	49/3
1,200,000	Stk. (5/-)	Canning (W.) & Co.	14/4½	+ 4½d.	15+8½C	25+ *2½C‡	5 4 3	19/6	13/3	18/1½	12/3
60,484	1/-	Carr (Chas.)	1/1½		NIL	12½	—	2/3	1/-	2/10½	1/3
555,000	1	Clifford (Chas.) Ltd.	26/6		10	10	7 11 0	35/-	26/-	30/-	22/6
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	16/-	15/3	16/-	17/-
300,000	2/-	Coley Metals	3/9		15	15	7 14 9	5/-	3/3	4/6	2/6
10,185,696	1	Cons Zinc Corp.†	70/-	- 3/-	20	15	5 14 3	80/-	60/6	77/3	57/9
5,399,056	1	Davy-Ashmore	139/-	+ 1/-	30‡	20	2 3 0	146/3	100/6	116/-	43/-
7,695,000	5/-	Delta Metal	20/3		17½	31‡	4 6 6	28/-	18/7½	26/4½	11/6
9,296,550	Stk. (£1)	Enfield Rolling Mills Ltd	47/9	+ 3d.	15	15	6 5 9	56/3	45/-	61/9	36/7½
1,155,600	1	Evered & Co.	44/-	+ 6d.	10B	10♦	3 0 0	42/9	29/-	42/6	30/-
18,000,000	Stk. (£1)	General Electric Co.	31/6	—3d.	10	10	6 7 0	51/6	29/3	50/6	30/-
1,500,000	Stk. (10/-)	General Refractories Ltd	48/9	+ 2/6	20	20	4 2 0	51/6	40/-	47/-	31/4½
750,000	5/-	Glacier Metal Co. Ltd	14/3		13	11½	4 11 3	15/9	11/1½	11/3	6/7½
2,500,000	5/-	Glynwed Tubes	24/-	+ 7½d.	25G	20	3 10 6	27/1½	17/7½	30/9	16/1½
7 228,065	10/-	Goodlass Wall & Lead Industries	37/6	+ 1/-	19L	16	3 16 0	41/6	33/4½	53/-	28/7½
696,780	10/-	Greenwood & Batley	25/9xc2p		30W	30	5 16 6	133/9	112/6	130/-	75/-
792,000	5/-	Harrison (B'ham) Ord.	12/4½	—3d.	*20‡	*17½	4 0 9	15/4½	11/9	26/9	14/-
150,000	1	Ditto Cum. Pref. 7%	20/-		7	7	7 0 0	20/-	19/3	19/6	19/4½
1,075,167	5/-	Heenan Group	12/3	+ 9d.	13D	15	4 12 6P	12/6	10/-	19/6	7/4½
249,932,548	Stk. (£1)	Imperial Chemical Industries	71/-		11½N	8	3 3 6	75/3	54/-	62/7½	33/1½
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/9	+ 1½d.	5	5	6 7 0	17/9	15/3	19/1½	15/6
22,184,044	**	International Nickel	112½	+ 1½	$1.60	$1.50	2 9 0	113½	85½	201½	154½
300,000	1	Johnson, Matthey & Co Cum Pref 5%	14/6	+ 6d.	5	5	6 18 0	16/6	14/6	17/6	14/9
6,000 000	1	Ditto Ord.	62/6	+ 6d.	12	12D	3 16 9	66/6	45/-	50/3	27/3
600.000	10/-	Keith, Blackman	20/3	+ 6d.	17½	17½E	8 13 0	32/6	17/9	32/-	25/-
320,000	4/-	London Aluminium	10/-	+ 9d.	12	10	4 16 0	12/6	7/6	10/7½	5/3
765,012	1	McKechnie Bros Ord	57/-		17½F	15F	6 2 9	71/6	57/-	62/6	39/9
1,530,024	1	Ditto A. Ord	53/9		17½F	15F	6 10 3	69/3	55/-	65/6	38/9
1,108,268	5/-	Manganese Bronze & Brass	14/9	+ 3d.	20⅝	20⅝	7 0 0	18/9	13/4½	19/-	13/6
50,628	♦	Ditto (7½% N.C. Pref.)	6/-		7½	7½	7 10 0	6/6	6/-	7/9	5/9
21,745,110	Stk. (£1)	Metal Box	80/6	+ 4/6	12M	13B	2 14 6	83/-	55/9	80/-	44/7½
418,760	Stk. (2/-)	Metal Traders	7/3	+ 3d.	50	50	13 15 9	10/4½	7/1½	13/6	8/4½
160,000	1	Mint (The) Birmingham	36/9	+ 3d.	6	10	5 8 9	39/-	33/6	35/-	22/-
80,000	5	Ditto Pref. 6%	76/3		6	6	7 17 6	80/-	75/-	80/-	69/-
5,187 938	Stk. (£1)	Morgan Crucible A	55/3	+ 6d.	13	12	4 14 0	62/3	47/6	52/6	30/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref.	16/-		5½	5½	6 17 6	18/6	15/9	19/3	17/3
3,850,000	Stk. (£1)	Murex	40/7½		22½ J	15	6 8 0	45/-	35/3	76/4½	41/-
385,000	5/-	Ratcliffs (Great Bridge) Ord	16/6		10	10R	3 1 6	17/-	14/9	—	
195,000	5/-	Ditto 8% Max. Ord.	5/-		8	—	8 0 0	5/3	5/-	—	
1,064,880	10/-	Sanderson Kayser	34/3		35‡	25	5 2 3	40/3	27/7½	56/-	27/9
3,400,500	Stk. (5/-)	Sarck	16/1½	+ 7½d.	12½	17½GD	3 17 0	25/-	15/3	26/-	12/-
7,232,069	Stk. (£1)	Stone-Platt Industries	63/6	+ 7/6	15	15	4 14 6	64/3	52/3	63/6	42/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/6		5½	5½	6 17 6	18/7½	15/3	18/9	15/10½
33,989,712	Stk. (£1)	Tube Investments Ord.	75/3	+ 3d.	14	20	3 15 9	95/9	66/3	138/-	71/7½
41,000,000	Stk. (£1)	Vickers	28/9		10	10	6 19 3	39/-	27/3	40/6	26/10½
750.000	Stk. (£1)	Ditto Pref 5%	13/-	—6d.	5	5	7 13 9	17/6	14/-	17/3	14/3
6,863.907	Stk (£1)	Ditto Pref. 5% tax free	19/9	—3d.	*5	*5	7 10 6A	24/3	20/-	25/9	20/6
4,594,418	1	Ward (Thos. W.) Ord.	64/9	+ 3d.	13½	25	4 4 0	86/-	64/-	167/6	83/-
7,109,424	Stk (£1)	Westinghouse Brake	38/9	+ 1/-	11	10	5 13 6	59/9	36/6	60/7½	39/-
225,000	2/-	Wolverhampton Die-Casting	9/6		35	30	7 7 3	13/10½	8/3	13/1½	8/8½
591,000	5/-	Wolverhampton Metal	29/-	—3d.	32½	27½	5 12 0	39/6	23/9	34/3	21/6
156,930	2/6	Wright, Bindley & Gell	4/-	+ 4½d.	15	20‡	9 7 6	4/3	2/10½	4/3	2/6
124,140	1	Ditto Cum. Pref. 6%	13/6		6	6	8 17 9	15/3	13/3	14/3	12/10½
150,000	1/-	Zinc Alloy Rust Proof	5/-	+ 3d.	40	30	8 0 0	5/6	4/-	3/10½	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corps. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. *The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. ♦ and 6½% from Capital Profits B and 50% capitalized issue. G and 1½d. special distribution. F and special 5% tax free dividend. H As forecast. G And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. N Interim since increased. J and 75% capitalized issue. S and 40% capitalized issue. O calculated at 13⅓%. Interim on smaller capital. P Calculated at 11½%. Q also 1/- special tax free dividend and 50% capitalized issue. T Per £1 unit. W Before capital reorganization. Calculated at 15%.

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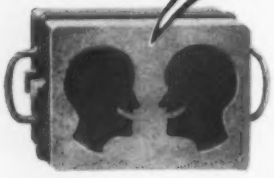

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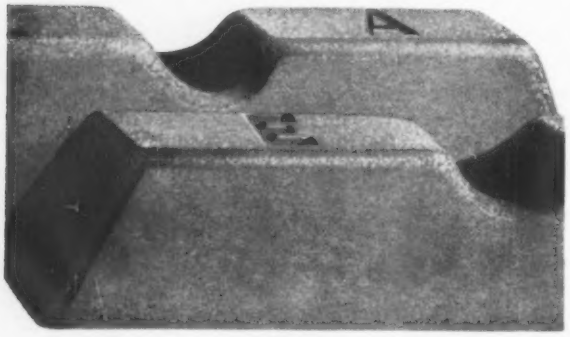

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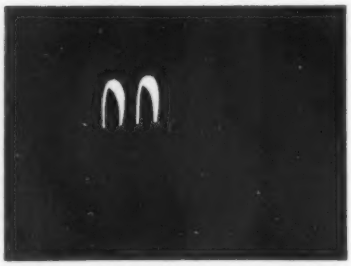

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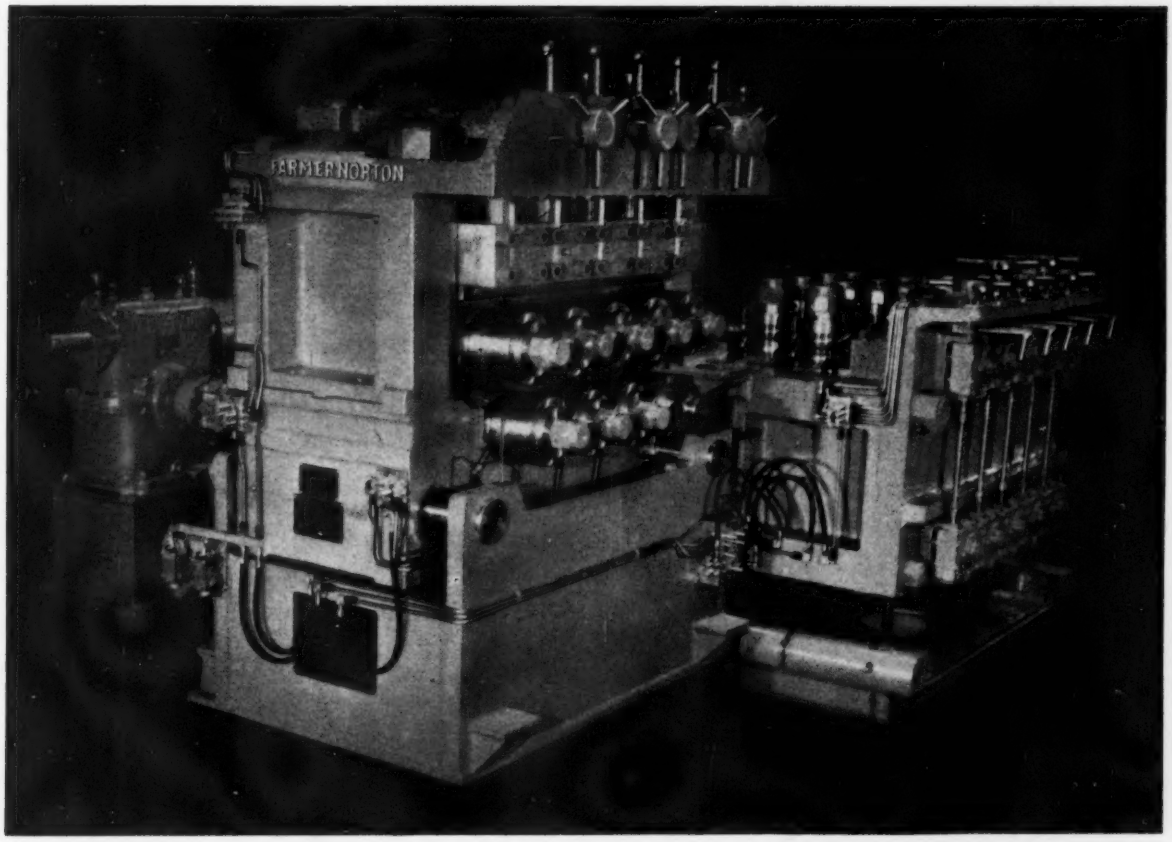

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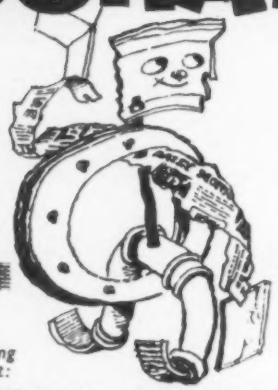

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INDEX TO ADVERTISEMENTS

	Page
AEI-Birlec	—
Alcan (U.K.) Ltd.	—
Alexander Metal Co. Ltd.	—
Alkan Ltd., M. L.	—
Allan & Co. (Glenpark) Ltd., John	—
Alreco Metal Corporation Ltd.	—
Aluminium Bronze Co. Ltd.	—
Aluminium Corporation Ltd.	—
Anglo-Swiss Alum. Co. Ltd.	—
Arnold, Edward	—
Ashby, Morris, Ltd.	—
Ashley Associates Ltd.	—
Associated Lead Manufacturers Ltd.	—
Associated Pressings Ltd.	—
Aston Tubes (Non-Ferrous) Ltd.	—
Atlas Metals & Alloys Co. Ltd.	*Inside front cover*
Austin & Sons (London) Ltd., E.	14
Autocar	—
Auxiliary Rolling Machinery Ltd.	—
Barnett Ltd., H.	—
Batchelor Robinson & Co. Ltd.	—
Beta Ltd.	—
Birkett, Billington & Newton Ltd.	—
Birlec-Efco (Melting) Ltd.	—
Blackwell's Metallurgical Works Ltd.	*Outside front cover*
Bolton & Sons Ltd., Thomas	—
Bond Ltd., Charles H.	—
Booth & Co. Ltd., J.	—
Brayshaw Furnaces Ltd.	3
Brightside Plating Co. Ltd.	—
British Aluminium Co. Ltd., The	—
British Electrical Development Association	—
British Furnaces Ltd.	—
British Industrial Ingot Metals Ltd.	—
Brock Metal Co. Ltd., The	19
Bronx Engineering Co. Ltd., The	—
Brookes (Oldbury) Ltd.	—
Brooks & Co. (Metals) Ltd., T. J.	—
Brookside Metal Co. Ltd.	—
Buhler Bros.	—
Calorizing Corporation of Great Britain Ltd.	—
Camelinat & Co. Ltd., E.	*Inside front cover*
Canning & Co. Ltd., W.	—
Capper Pass & Sons Ltd.	—
Carlsrud, Conrad M.	—
Carrs Paints Ltd.	—
Catterson-Smith Ltd., R. M.	—
C.A.V. Ltd.	—
Chalmers & Co. Ltd., E.	—
Chemical Construction (G.B.) Ltd.	—
City Casting & Metal Co. Ltd.	—
Cohen & Co. Ltd., A.	—
Coley & Son (Hounslow) Ltd., R. J.	*Inside back cover*
Conder Engineering Co. Ltd.	—
Consolidated Zinc Corporation (Sales) Ltd.	12
Coulthard & Co. Ltd., William	—
Cramic Aircraft Components Ltd.	—
Crooks, L. E.	—
Cruickshank Ltd., R.	8
Deutsch & Brenner Ltd.	—
D.M.M. Machinery Ltd.	—
Doncaster & Sons Ltd., Daniel	—
Easdale & Co. Ltd., R. M.	—
Electric Resistance Furnace Co. Ltd.	—
Electro-Chemical Engineering Co. Ltd.	—
Elton Levy & Co. Ltd.	—
E.M.B. Co. Ltd.	1
Engers Ltd., M. C.	—
English Electric Co. Ltd.	—
Enthoven & Sons Ltd., H. J.	—
Entores Ltd.	—
E.N.V. Engineering Co. Ltd.	—
Essex Metallurgical Ltd.	—
Eyre Smelting Co. Ltd., The	—
Farmer Norton & Co. Ltd., Sir James	15
Ferranti Ltd.	—
Firma-Chrome Plating Co. Ltd., The	—
Foundry & Metallurgical Equipment Co. Ltd.	—
Foundry Flux Ltd.	—
Franklin Furnace Co. Ltd.	—
Frost Ltd., N. T.	20
Garnham & Sons Ltd., J. B.	—
Gas Council, The	—
General Refractories Ltd.	—
Gibbons Brothers Ltd.	—
Gibbons (Dudley) Ltd.	5
Gills Pressure Diecastings Ltd.	—
Grauer & Weil Ltd.	—
Great Bridge Foundry Co. Ltd.	—
G.W.B. Furnaces Ltd.	9
Hadfields Ltd.	—
Hall Foundries Ltd.	—
Hall Street Metal Rolling Co. Ltd.	—
Hampton Works (Stampings) Ltd.	—
Harris (Birmingham) Ltd., F. W.	—
Harris Plating Works Ltd.	—
Harshaw Chemicals Ltd.	—
Head Wrightson Machine Co. Ltd.	—
Heneage Metals Ltd.	—
Hilger & Watts Ltd.	10
Hockley Chemical Co. Ltd.	—
Holroyd & Co. Ltd., John	—
Ilfar Aluminium Co. Ltd.	—
Iliffe Books Ltd.	—
Imperial Aluminium Co. Ltd.	—
Imperial Chemical Industries Ltd.	—
Incandescent Heat Co. Ltd., The	—
Industrial Research Laboratories	—
International Alloys Ltd.	2
International Refining Co. Ltd.	—
Johnson & Co. (Birmingham) Ltd., George	—
Johnson & Co. Ltd., T. W.	13
Johnson & Sons Smelting Works Ltd.	*Inside front cover*
Jones & Co. Ltd., R.	—
Jones & Rooke (1948) Ltd.	—
Jones Ltd., George	*Inside back cover*
Joseph & Sons Ltd., M.	18
Laidlaw Drew & Co.	—
Lazarus Ltd., Leopold	—
Lead Development Association	18
Levick Ltd., John	—
Lindemann Maschinenfabrik G.m.b.H.	—
London & Scandinavian Metallurgical Co. Ltd.	—
McGhee (Metals) Ltd., Hugo	14
McKechnie Bros. Ltd.	—
Magnesium Elektron Ltd.	—
Manganese Bronze & Brass Co. Ltd.	—
Marshall Richards Machine Co. Ltd.	—
Maybank (Metals) Ltd., J. & J.	16
Metal Castings Ltd.	7
Metal Distributors (U.K.) Ltd.	—
Metallic Extractors (Non-Ferrous) Ltd.	—
Metals & Methods Ltd.	—
Midland Metallics Ltd.	—
Midland Monolithic Furnace Lining Co. Ltd.	—
Milner Metals Ltd., A. E.	18
Mint, Birmingham, Ltd., The	—
Mitcham Smelters Ltd.	—
Modern Furnaces & Stoves Ltd.	—
Mond Nickel Co. Ltd., The	—
Monometer Manufacturing Co. Ltd.	—
Morgan Crucible Co. Ltd.	*Outside back cover*
Morris Ltd., B. O.	—
National Industrial Fuel Efficiency Service	16
New Metals & Chemicals Ltd.	—
Newton Collins Ltd.	—
Nickel Anodes & Non-Ferreous Castings Ltd.	6
Northern Aluminium Co. Ltd.	—
Oakey & Sons Ltd., John	—
Ormerod Ltd., R. E.	—
Park & Paterson Ltd.	—
Peco Machinery Sales (Westminster) Ltd.	—
Perry & Co. Ltd., B. J.	19
Platt Metals Ltd.	—
Powder Metallurgy Ltd.	18
Priestman Ltd., T. J.	14
Rapid Magnetic Ltd.	—
Rhondda Metal Co. Ltd.	—
Robertson & Co. Ltd., W. H. A.	—
Rollet & Co. Ltd., H.	—
Roper & Co. Ltd., E. A.	—
Schloemann, A.G.	—
Senier & Co. Ltd., T. W.	—
Sheffield Smelting Co. Ltd.	4
Shell-Mex & B.P. Gases Ltd.	—
Sheppard & Sons Ltd.	—
Silvercrown Ltd.	—
Simpson (Assayer) Ltd., Gordon	—
Sklenar Furnaces Ltd.	17
Smith & Sons (Clerkenwell) Ltd., J.	—
Stedall & Co. Ltd.	—
Stein & Atkinson Ltd.	—
Stein & Co. Ltd., John G.	—
Strebor Diecasting Co. Ltd.	—
Stuart (London) Ltd., Robert	—
Thermal Syndicate Ltd.	—
Threadgill Electro Deposits Ltd.	—
U.K.A.E.A.	—
Union Carbide Ltd.	—
United Coke & Chemicals Co. Ltd.	—
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Vickers-Armstrongs (Engineers) Ltd.	—
Ward Ltd., Thomas W.	—
Western Diecastings Ltd.	—
West Instrument Ltd.	—
West Yorkshire Foundries Ltd.	—
Westinghouse Brake & Signal Co. Ltd.	—
Westland Aircraft Ltd.	—
Wilkes Chemical Co. Ltd., Henry	—
Wilkins & Mitchell Ltd.	—
Williams Brothers & Piggott Ltd.	—
Wolverhampton Metal Co. Ltd.	—
Wolverhampton Trading & Scrap Co. Ltd.	—
Wright, Bindley & Gell Ltd.	—
Yorkshire Engineering Supplies Ltd.	—
Young Ltd., T. W.	16
Zinc et Alliages	—

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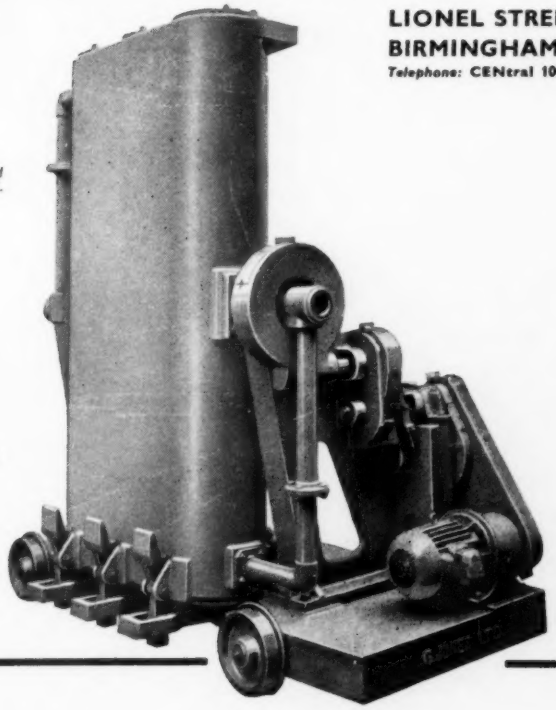

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